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CONTENTS

NATURAL FORESTS OF CHILE 155
by A. Hyndman Stein

STUDY OF TROPICAL VEGETATION 161
by P. W. Richards

CONTROL OF BRUSH AND UNDESIRABLE TREES: III 166
by Arthur W. Sampson and Arnold M. Schultz

SCIENTIFIC NOMENCLATURE OF FOREST TREES 183
by Elbert L. Little, Jr.

COMMODITY REPORT 186
Sawn Softwood

THE WORK OF FAO
Mediterranean Forestry Problems 192
FAO/IUFRO Committee on Bibliography 192
FAO Panel on Forestry Education 193
Latin-American Forest Research and Training Institute 193
Technical Assistance Notes 194

EQUIPMENT SECTION 196

NEWS OF THE WORLD 199

BOOK NOTICES 202

CLASSIFIED INDEX TO VOLUME 10 204

NEW DIRECTOR-GENERAL FOR FAO

ALL friends and, indeed, critics of FAO can welcome the election of Mr. B.R. Sen as the new Director-General of the Organization. He will bring to bear a keen mind and fresh ideas on the affairs of FAO, backed by very considerable and varied administrative experience.

He is the first Asian to be executive head of a United Nations agency. The other agencies are headed by three Americans, four Europeans and two Latin Americans.

As Ambassador of India to the United States and later to Italy, Mr. Sen has been closely associated with FAO's activities from the time the Organization started to grow in Washington and then after its headquarters had been transferred to Rome. Earlier he had been Director-General of the Food Department in India and a Secretary to the Government. Trained to the strict standards of the Indian Civil Service, he has since represented his country on the United Nations Security Council, and led the Indian Delegation to the Economic and Social Council and to many sessions of the FAO Conference. His chairmanship of various commissions of the FAO Conference, from as far back as 1948, has given him an intimate knowledge of FAO's technical programs and problems.

Mr. Sen's election to the post of Director-General came as a dramatic feature of the Third Special Session of the FAO Conference held in September last, after the candidate of the United States had withdrawn before the third ballot, when seemingly almost assured of the necessary votes. As Mr. Sen, in a speech after his election, said:

"When victory is in sight, to give away the privilege of being elected is an act of courage and self-denial ... We feel, and we believe, that the United States of America has taken note of the growing desire on the part of the less-developed areas at this stage to come and take over the direction of the affairs of FAO, even if only for a time. This shows great understanding on the part of the United States of America. It is only a big nation with a big heart that can have this kind of understanding ... We are greatly heartened by the assurance which the United States of America has given that, though its candidate has been withdrawn, it will continue to give its fullest support to the Organization."

Mr. Sen continued:

"FAO, as we know, after ten years of its existence, is now facing many problems. Some of these problems have been dramatized, but I have always had the belief that of all the specialized agencies ... there is none which is doing as good work as FAO. At times we do meet difficulties, but what organization does not? We have internal problems; every organization has them ... I feel that with the co-operation of the Member Nations, with the co-operation of the staff, these problems that we hear of can be easily brought under control."

"The office of the Director-General is not just a job. That is the way, at least, I look at it, and am sure you all do. The Director-Generalship of FAO is both a challenge and an opportunity. A challenge to the best that a man has in himself, and can give; an opportunity of service to humanity. It is in this spirit of challenge and opportunity that I shall undertake this task which you have now imposed on me."

In some parts of Asia, notably Burma, Thailand, and parts of India, elephants are still extensively used in forest operations, where the use of mechanized equipment is neither practical nor economic. This photograph, taken by a staff member of FAO during the study tour of the Teak Sub commission, shows elephants stacking teak logs in northern Thailand.

Photograph: S. Bunnag

FIGURE 1. *Stand of natural forest of* Jubaea spectabilis *(Chilean palm) at Ocoa, Valparaiso province, 32° 50′ S.*

FIGURE 2. *Stand of natural forest of* Nothofagus dombryi *and* N. procera *killed by fire, Villarriea forest reserve, Cautin province, 39° 20′ S. Regrowth of* Chusquea *on left.*

Natural Forests of Chile

by A. Hyndman Stein
FAO Forestry Mission, Chile

The occurrence, extent, distribution and composition of the natural forests of Chile are influenced greatly by latitude and altitude, even more so by these factors than in other countries, owing to Chile's unique configuration. Local factors, such as soil and water conditions and aspect, affect their composition to some extent, while man must be held responsible for their present condition.

Northern Region

Thus, in the Northern provinces of Tarapacá, Antofagasta and Atacama — the Norte Grande — desert conditions discourage the occurrence of natural forests, and such woody vegetation as occurs is xerophilous and restricted to certain localities. On the inland pampa at about 1,000 meters in altitude, where subterranean water is available, occur patches of the deep rooted indigenous species, *Prosopis tamarugo* (tamarugo). Possibly there may have been more extensive natural patches of this species formerly, which disappeared gradually over the centuries by exploitation for fuel required for smelting of silver in the Inca period, and more recently by exploitation for fuel for nitrate factories. Such patches as are found now are principally the result of afforestation. The species *Prosopis siliquastrum* (algarrobo) introduced from Argentina, is often found growing in association with tamarugo. At elevations between 4,000 and 5,000 meters in the high Andes in this region, where short sharp showers of rain are received in the summer, occur *Laretia compacta* (llareta), a curious woody member of the family *Umbeliferae* which forms cushion-shaped masses, consisting of the tightly packed shoots of the plant, thus enabling it to withstand arid conditions. However, this species is light-demanding and favors sunny northern aspects. It is prized greatly as fuel for the population of mining centers, such as Chuquicamata, and other small towns such as Calama, as well as for the light railway from Arica to the altiplano of Bolivia.

Central Region

In the province of Coquimbo and Aconcagua, and small portions of Valparaíso and Santiago provinces — Norte Chico — the climatic conditions are more favorable for woody growth. The rainfall varies from 10 to 40 centimeters according to locality, but almost all occurs in winter, and most of the species found are xerophilous. An exception is the patch of forest at Fray Jorge in the outer slopes of the coastal range near Coquimbo, where the humidity induced by the impact of moisture-laden coastal fog against these slopes permits the growth of hygrophilous species. This region contains tracts of open woodland with a large variety of woody shrubs, which are valuable spring pastures for sheep. Towards the south of this region, *Acacia cavenia* (espino) occurs on level sites. In the re-entrants, carved by streams on hillsides, especially on shady aspects, occur evergreens with leathery leaves such as *Quillaja saponaria* (quillay), *Cryptocaria rubra* (peumo), *Lithraea caustica* (litre), and *Boldea boldus* (boldo). The large demand for fuel in this region has caused the disappearance of much of the original woody growth, and the formation of plantations, mainly of eucalyptus with the assistance of irrigation. The bark of quillay is an article of commerce, and in 1954, 635 tons, worth almost one million gold pesos, were exported.

Transition Provinces between Central and South Chile

In the region comprising the southern portion of Valparaíso and Santiago provinces to the provinces of Arauco and Malleco, which have to be considered as transition provinces between central and south Chile, as portions of these provinces have affinities to one or other, rainfall also occurs mainly in winter, but increases progressively from north to south. Also the outer slopes of the coastal cordillera and the Andean slopes usually receive more rain than the central plain.

Thus Santiago has an average annual rainfall of 40 centimeters, Linares 100 centimeters, Chillán 117 centimeters, while Concepción has 150 centimeters with a better distribution, each summer month having from two to seven centimeters. These rainfall conditions are reflected by the character of the natural woodlands and forests of this region. The typical tree species of the natural vegetation of the central plain and adjoining foothills as far south as Ñuble province, about 37°S., is *Acacia cavenia* (espino), though years ago most woodlands of this species gave place to cultivation. The sheltered valleys of the coastal range in Valparaíso and Santiago provinces formerly contained dense stands of Chilean palm (*Jubaea spectabilis*), of which only two remain at Ocoa and Cocalán. The coastal range and lower Andean slopes have open woodlands of xerophilous woody shrubs, a deciduous species of Nothofagus, described by Reiche as *Nothofagus obliqua* var. *macro-*

carpa (roble blanco) and leathery-leaved evergreens such as quillay, litre and boldo, as far as Colchagua province, south of which they begin to be replaced by open forests comprised mainly of deciduous species of Nothofagus, *Nothofagus glauca* (roble maulino or roble colorado), *Nothofagus leoni* (hualo) and *Nothofagus alessandri*.

At higher elevations in the Andes, an evergreen species, *Nothofagus dombeyi* (coigüe) begins to occur from Colchagua province, and a deciduous species, *Nothafagus procera* (raulí) from Talca province, while two other deciduous species, *Nothofagus pumilio* (lenga) and *Nothofagus antarctica* (ñirre), begin to occur at the tree limit, about 2,000 meters in this region, from Ñuble province. Similarly on the central plain in this region the deciduous species, *Nothofagus obliqua* (roble, roble pellín) begins to replace the *Acacia cavenia* formation from just north of Yungay about 37°S at first as scattered trees in fields now under cultivation, the remnants of the former forests. The forests of the Andean foothills in Ñuble, Bío-Bío and Malleco provinces, composed mainly of roble, raulí and coigüe, improve in quantity and quality as one progresses southwards, and Malleco has extensive tracts of natural forest of this type. The northern limit of *Araucaria araucana* (pino araucaria) is at Antuco Volcano 27° 30′S, in the Andes, but forests of this species are found also on the tableland of Nahuelbuta at 1,000 meters in the coastal cordillera of Arauco province. *Libocedrus chilensis* (ciprés de cordillera), the most northerly indigenous conifer, begins to occur on the Andes at high elevations up to about 1,800 meters from Colchagua province.

Roble maulino, hualo and *Nothofagus alessandri* do not extend southwards of Maule province, but all other species of Nothofagus which occur in this region, that is coigüe, raulí, roble, lenga and ñirre, extend far to the south, lenga and ñirre actually to Tierra del Fuego. Similarly, ciprés de cordillera and pino araucaria extend to the south of the limits of this region.

This region of Chile is well developed agriculturally, contains the three largest cities of the country, many of the industries and over 70 percent of the population. Consequently, the accessible natural forests of this region have been over-exploited, but their disappearance has been compensated, north of Talca to some extent, and south of that province, more adequately by the formation of plantations, *Pinus radiata*, *Eucalyptus globulus* and *Populus nigra italica*. The Concepción zone, consisting of Maule, Linares, Concepción, Ñuble and Bío-Bío provinces and the transition provinces of Arauco and Malleco, have a great concentration of plantations, and contain collectively over 90 percent of the country's plantations of *Pinus radiata*.

Southern Region

The southern region of Chile, commencing from the transition provinces of Arauco and Malleco and extending to Magallanes, about 1,700 kilometers in length, has, in general, a rainy temperate climate, though as may be expected over such a great range of latitude, the rainfall and temperature present many variations. Thus, Temuco on the central plain has an average annual rainfall of 140 centimeters; Puerto Montt, 175 centimeters; Valdivia, 245 centimeters; the western slopes of the Andes at high elevations and outer islands at sea level are believed to have as much as 500 centimeters, while the trans-Andean tract in Aysen and Magallanes is notably drier with a rainfall of only 15 to 40 centimeters. This great difference in rainfall produces entirely different types of natural forest on the maritime and continental sides of the main cordillera in Aysen and Magallanes provinces, the crest of this cordillera being above the tree line, and much of it is glaciated. The temperatures in general diminish from north to south, and from sea level to the mountain heights. The intense cold of winter and the strong winds of summer on the Patagonian steppes, combined with the low rainfall, exert a great influence on the occurrence and nature of the tree growth in that locality. The tree line varies from about 1,700 meters in the north of this region to only a few hundred meters above sea level in the extreme south.

This vast region of Chile contains the major part of the natural forests and woodlands of the country, having 85 percent by area of the total area of all types of natural forest and woodland, and what is even more significant, 96 percent of the total area of commercial natural forests of Chile. It is probable that, before man arrived on the scene and influenced Nature's scheme, the whole of this region, excepting the high altitude above the tree line, the arid portions of the Patagonian steppes and occasional natural meadows, was covered with forest growth, generally dense, composed mainly of broadleaved species of types which can still be observed, as certain portions, mainly owing to their inaccessibility, remain intact. However, the view has been put forward that at the time of the Spanish Conquest much of the central plain was not densely forested, but that dense forests developed on this plain subsequently, and there is a considerable weight of evidence in support of this view. As a matter of interest it may be mentioned that fossils found in Patagonia show that many million years ago this region had forests of conifers resembling certain species of the genus *Araucaria*. Also the great age of *Fitzroya cupressoides* (alerce), found in the Lago Llanquihue - Puerto Montt tract, suggests that alerce forests have existed in that tract for thousands of years.

The Nothofagus species

A feature of the present day forests is the predominance of species of the genus *Nothofagus* (*Fagaceae*). As we have seen, certain species occur in the region of Chile further north, but it is in this region that coigüe, raulí, roble, lenga, ñirre reach their optimum and certain other species of the genus occur. It is of interest to note that the first species of this genus which became known to science, as a result of Captain Cook's voyage 1769-71, was *Nothofagus antarctica*, which is the poorest

species of *Nothofagus* occurring in Chile, from the point of view of timber production. It was first known as *Fagus antarctica* until the genus *Nothofagus* was formed in the middle of the 19th century, by which time it was realized that the beeches of the southern hemisphere were distinct from those of the northern hemisphere. As well as occurring in South America, principally in Chile, species of *Nothofagus* are found in New Zealand, Tasmania, Australia and New Guinea. In the natural forests of this region of Chile, three evergreen and five deciduous species of *Nothofagus* are estimated as comprising collectively $^{2}/_{3}$ of the forests, the remaining $^{1}/_{3}$ consisting of a number of other hardwoods, mainly evergreen and eight species of conifers.

Mixed stands are much more plentiful than pure stands, though there are exceptions such as the extensive forests of the deciduous *N. pumilio* (lenga) in the trans-Andean tracts in Aysen and Magallanes, stands of the evergreen *N. dombeyi* (coigüe) and *N. betuloides* (roble de Magallanes), in the area of high rainfall and patches of conifers, pino araucaria, alerce and *Pilgerodendron uviferum* (ciprés de las guaitecas), on particular sites characteristic of these species. However, as the occurrence of individual species depends greatly on latitude, altitude and other factors, sites, even in the case of mixed stands, seldom contain more than ten or a dozen species, of which only three or four are dominant.

Deciduous species of *Nothofagus* occur mainly in the north and south of this region, that is, the drier zones of the region, the first comprising Arauco, Malleco, Cautín, Valdivia and Osorno provinces, except the tablelands and outer slopes of the coastal cordillera of these provinces, the second comprising the trans-Andean tract in Aysen and Magallanes, including Tierra del Fuego.

In the drier northern zone, the principal deciduous species, which are always the dominant species of their stands, are *Nothofagus obliqua* (roble) and *Nothofagus procera* (raulí). The former favors well-drained sites on the central plain, and up to an elevation of about 800 meters generally, though the upper limit of this species varies with the aspect and stands have been observed at 1,000 meters. Raulí grows well between 600 to 1,300 meters, especially in the Andes. Llanquihue province and Valdivia province may be considered as the southern latitudinal limits of these two species respectively.

Two other deciduous species, *N. pumilio* (lenga) and *N. antarctica* (ñirre) also occur, but at higher eleva-

FIGURE 3. *Natural forest of* Nothofagus obliqua *of good quality, after partial removal for cultivation and pasture, on steep slopes in Llancacura forest reserve, Valdivia province, 40° 20′ S. Agricultural landscape of the Rio Bueno tract of Osorno province in background.*

FIGURE 4. *Typical landscape in Cautin province, 38°, 40′ S. Stumps, charred stems and a few living survivors of the former rich* Nothofagus *forest which has been replaced by cultivation.*

tions, generally from 1,300 meters to the tree line, about 1,700 meters in this zone, though ñirre in the form of low trees or scrub, is found frequently on poorly drained valley floors from 800 meters upwards. The deciduous species of this northern zone, except lenga and ñirre, which are more often found in pure stands, occur generally in association with evergreens, the principal dominant or codominant broad-leaved species being coigüe, which, however, tends to occur in pure stands, and is very plentiful, forming more than 40 percent of the forests of Valdivia province. *Laurelia serrata* (tepa) is the next most abundant evergreen associate, sometimes in the form of a codominant species but more often forming a definite second storey. Other evergreen associates, which usually are in the form of codominants, are *Laurelia sempervivens* (laurel), a mixture of this species with roble being characteristic of parts of the central plain in Osorno and Llanquihue as far south as Frutillar, *Eucryphia cordifolia* (ulmo), *Aextoxicon punctatum* (olivillo), *Weinmannia trichosperma* (tineo or palosanto), *Persea lingue* (lingue) and *Drimys winteri* (canelo). The principal evergreen associates which usually occur as subdominants are *Myrtus luma* (luma), *Myrtus meli* (meli), *Tepualia stipularis* (tepu), *Myrceugenia apiculata* (arrayan), *Flotowia dicanthoides* (trevo), *Lomatia obliqua* (radal), *Guevina avellana* (avellana), *Embothrium coccineum* (notro or ciruelillo) and *Boldea boldus* (boldo). But, as many of these species are typical of the moister sites along streams or in marshy places, where they form dense low forest, on such sites they become the dominant or codominant species.

In the drier southern zone, representing the trans-Andean tract in Aysen and Magallanes, including Tierra del Fuego, the main deciduous species are lenga and ñirre, and most of the forests of this zone consist of pure stands of lenga, generally with an undergrowth of *Berberis spp.* (michai or calafat). Another deciduous species of *Nothofagus* occurs in Tierra del Fuego, namely *Nothofagus montagnei*, which resembles ñirre.

The remainder of this region, that is, the mesetas and maritime slopes of the coastal cordillera in the north of the region, the central plain southwards from about 41° S. and all islands and maritime slopes of the continent south of Puerto Montt to Cape Horn, is populated by a forest, typically evergreen, and which may be regarded as a temperate zone " rain " forest, on account of the copious rainfall. Three evergreen species of Nothofagus are characteristic, namely coigüe, which occurs as far south as Aysen province, *N. nitida* (roble de Chiloé) which occurs from Osorno to Aysen but mainly in Chiloé, and *N. betuloides* (roble de Magallanes), which occurs from the meseta of the coastal cordillera in Valdivia province to the Straits of Magallanes. Other very common species of this " rain " forest are canelo and luma. All other evergreen species mentioned as associates in the deciduous forests of the northern drier zone occur also in the " rain " forest in the north of the region, but certain species disappear south of Chiloé.

Coniferous species

The natural forests of the southern region, though predominantly composed of hardwood species, are not entirely so, coniferous species forming about 7 percent.

The association, often intimate, of coniferous with broadleaved species is a characteristic feature of the natural forests of Chile, so unlike the occurrence of conifers in the northern hemisphere where they tend to form extensive pure stands or occur in mixture with other coniferous species rather than broadleaved.

Eight indigenous species of coniferous are found, namely *Araucaria araucana* (pino araucaria), *Fitzroya cupressoides* (alerce), *Pilgerodendron uviferum* (ciprés de las guaitecas), *Libocedrus chilensis* (ciprés de cordillera), *Podocarpus andinus* (lleuque), *Podocarpus nubigenus* (mañio hembra), *Podocarpus salignus* (mañio) and *Saxegothaea conspicua* (mañio macho), or nine, if the dwarf conifer *Dacrydium fonckii*, which occurs from the meseta of the coastal cordillera of Valdivia province southwards as far as Aysen, is included.

The first two of these species have restricted habitats. Pino araucaria is limited to the Andes between Antuco volcano (37°30' S.) and Lanin volcano (39°30' S.) at elevations from about 1,200 meters to the tree line, and as already mentioned, to the Nahuelbuta tract of the coastal cordillera, slightly north of 38° S., either forming pure stands, or occurring in mixture with coigüe and lenga, the latter only in the Andean habitat. Alerce, on the other hand, is a species of the "rain" forest. Its northern limit is the coastal cordillera of Valdivia province at elevations over 300 meters. Further south, as between Lago Llanquihue and Puerto Montt it is found on the central plain, and it continues to occur on moist sites in Llanquihue and Chiloé provinces, frequently in association with ciprés de las guaitecas. Alerce is the redwood of the natural forests of Chile, and attains great size under favorable conditions, and great age, 2,000 years or more.

Of the other conifers, ciprés de cordillera, lleuque and mañio occur mainly to the north of Osorno province, but ciprés de las guaitecas, mañio macho and mañio hembra are more typical of the heavy rainfall areas, and are found far to the south. Ciprés de cordillera frequents rocky sites. Lleuque is comparatively scarce. Mañio occurs on both cordilleras as well as on the central plain, and is generally an understorey tree below dominant deciduous or evergreen species. Ciprés de las guaitecas is dominant on moist sites as on the Isla Guaiteca, from which it derives its name. Mañio macho and mañio hembra are found generally as subdominants, though occasionally as codominants with broadleaved species.

The quality of growth in the natural forests of this region is by no means uniform. There are still some stands of raulí, coigüe, pino araucaria and alerce not yet exploited by men where large trees three meters in diameter at breast height and 40 to 50 meters in total height can be found, but such overmature trees generally have a high percentage of unsoundness. There are very extensive tracts of low forest (monte bajo), where there are few or no trees of saw timber size, and some tracts, such as the meseta of the coastal cordillera of Valdivia province, only have very stunted growth owing to the shallow soil and exposure. In general, the forests of highest quality are those of the Andean tract of Malleco, Cautín, Valdivia, Osorno and Llanquihue provinces, the quality being at its optimum in Cautín and Valdivia. The quality of the forests of the coastal cordillera of these provinces, also of the forests of Chiloé, Aysen and Magallanes, is notably lower, tending to deteriorate as the latitude or altitude increases.

A feature of the natural forests of South Chile is the dense undergrowth, sometimes consisting of the reproduction of shade-tolerant species such as tepa, luma and the three mañios, but much more frequently consisting of a profuse growth of *Chusquea* species (colihue and quila), which increase the silvicultural problem of regenerating these forests, especially as most of the higher value species such as raulí and roble are light-demanding. However, *Chusquea* gives shelter and fodder to cattle during winter when other green fodder is not available. At higher elevations in the Andes the undergrowth frequently consists of the alpine species of canelo; in the "rain" forest of Aysen fuchsia and ferns are plentiful; while in the deciduous forests of Aysen and Magallanes the most common forms of undergrowth are species of *Berberis* (michai or calafat).

Distribution of the Natural Forests

The present extent of all types of natural forests and woodlands is estimated at 16,090,000 hectares, or 22 percent of the total surface area, 74,177,000 hectares, of the country. Of these 16,090,000 hectares, 9,465,000 hectares are not available for production, being inaccessible or only rocky non-commercial natural forest and woodlands, and only 6,625,000 hectares are accessible commercial natural forest and woodlands. The latter figure gives slightly less than one hectare of productive forest per member of the population, which is close to the world average, and is considerably more than the figure for densely populated Asian countries which is only 0.3 hectare, but less than half of the figure, 2.5 hectares, in North America.

Also, as the foregoing description of natural forests in the various regions of Chile indicates, the distribution of natural forests is most unequal, both geographically and in relation to the population. For example, the proportion of forests to the total surface area varies from far below 1 percent in the three northern provinces to over 40 percent in the southern provinces, Arauco-Malleco to Magallanes, and the quantity of forest per member of the population varies from a tiny fraction of a hectare in the northern to over 13 hectares in the southern provinces.

Chile can be divided into two broad zones from the point of view of forest sufficiency. The northern zone from Tarapacá to Talca inclusive is a deficit area. This is unfortunate, on account of the large proportion of the population in the Santiago-Valparaíso area, and the long distance from the southern natural forests which raises transportation problems and makes timber very expensive at Santiago. The southern zone from

Maule-Linares to Magallanes is a surplus area, but the Concepción region is surplus only on account of the extensive plantations; the transition provinces, Arauco and Malleco, are surplus, partly on account of natural forests and partly on account of plantations, and the provinces to the south, Cautín and Magallanes, are surplus on account of their natural forests.

The Influence of Man

Man's influence on the occurrence, extent and distribution of natural forests may only have supplemented in minor degree the underlying natural factors, but it certainly has been the major cause of the present condition of most of the natural forests. This influence has been particularly decisive, one might even say destructive, in the past century. Before that, the scanty population and the lack of incentive for commercial exploitation probably limited the demand on the forests to a modest local scale. With the increase in population, the need of settlers for more land for cultivation and pasture, the growth of towns, the advent of a railway line linking Santiago with the southern province as far as Puerto Montt, and the subsequent development of export, the natural forests became subject to a relentless ever-increasing pressure.

The land tenure policy, introduced by the Spanish and largely retained after independence was won by Chile, combined with the policy of giving private initiative a free hand in clearing forest land for cultivation and pasture, had the result that much forest land came to be considered the property of private individuals. North of Puerto Montt, the State-owned forest lands are limited to a few reserves, in most of which concessions for the commercial exploitation of timber were granted freely, and occupation was permitted, or took place illegally, until quite recently: 52 percent of the total area of the State forest reserves, 945,726 hectares, are estimated as being so occupied. In the southern part of Magallanes, including Tierra del Fuego, former forest land is now held on concessions or in some cases is occupied by sheep farmers, and it is only in Chiloé and Aysen provinces, also in parts of Llanquihue and Magallanes, but especially in Aysen, that extensive tracts of forest land, still owned by the State, at least nominally, remain, and these forest lands generally contain forests inferior in quality to those in private ownership further north. It is estimated that of the total area of all types of forest and woodland, including plantations, 54.5 percent are privately owned; 42.7 percent by the State and 2.8 percent are in undetermined ownership.

The private owners for the most part have been interested only in immediate maximum returns from the natural forests, and in getting them cleared as quickly as possible without heed to the future. The difficulties of exploitation, poor communications and distance from markets have encouraged selective fellings, that is felling of only the best trees of a few species of high value, frequently accompanied by the destruction of the remainder. This destruction, sometimes deliberate with the intention of clearing the land and sometimes wanton, was done through the agency of fire, a practice which has not helped to develop a public conscience on the subject of protection of the forests from fire. Extensive tracts in South Chile, where the clearing is still in progress, are encumbered by the grey specters of dead trees, stumps of exploited trees and semi-charred logs, many of which are sound internally and could be salvaged. The use of fire to effect clearing has frequently had the good effect of stimulating the regeneration of certain species, notably roble, raulí and coigüe, but where the original fire has been followed by repeated clearings and further fires, or where grazing has taken place, the young tree growth has been damaged severely or destroyed.

The selective fellings practiced have had the natural but unfortunate result of overcutting the species of high value, to mention a few, lingue, radal, ciprés de cordillera, laurel, raulí, roble, pino araucaria and alerce, in that these species have become increasingly scarce and some are threatened with extinction. For example, the production of saw timber of lingue, laurel, raulí and roble in 1945-46 was, in round figures, 850,000, 3.75 million, 5 million and 9 million pulgadas [1] respectively, but in 1952-53 the production of sawn timber of these species was only 250,000, 1 million, 2.5 million and 3 million pulgadas respectively.

At present the center of natural forest exploitation is represented by Valdivia, Cautín and Malleco provinces in that order, which produce over 60 percent of the total production of sawn timber of the country. The place of forest exploitation as a source of employment is indicated by the fact that, in 1953-54, 599 sawmills were in operation and employed about 12,000 workers.

The standing volume of the remaining productive natural forests has been estimated at 1,500 million cubic meters, and their gross annual increment at 17.5 million cubic meters. On the other hand, their annual losses, owing to natural causes such as decay, effect of wind, insects and fungi, as well as fire, generally caused by man, and exploitation have been estimated as 43 million cubic meters.

These figures indicate a very grave state of affairs, which if not corrected will lead to the exhaustion of the productive natural forests within the next 50 to 60 years.

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[1] One pulgada = 10 board feet.

Study of Tropical Vegetation

With special reference to British Guiana and British West Africa

by P. W. Richards,
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Under the auspices of UNESCO a Symposium on the Study of Tropical Vegetation was organized in Ceylon during March 1956. In the organization of this Symposium UNESCO consulted FAO's Forestry and Agriculture Divisions and invited participation of FAO representatives. A number of foresters in Southeast Asia were also invited, at FAO's suggestion, to present papers. A list of the papers presented is given on page 165. This article by Professor P. W. Richards is reproduced with the kind permission of the author and of UNESCO.

Following the presentation of the papers, conclusions and recommendations were formulated by the participants on such major topics as ecological factors, vegetation types and their methods of study, mapping, concept of climax in the tropics, and regimentation as a factor for judging the status of vegetation types. In view of the fruitful results of the meeting, it was recommended that UNESCO should organize future symposia, first on soils, a second on climate, both in relation to vegetation; and a future symposium on co-ordinating aims and methods of study of tropical vegetation, climate and soil.

Problems of tropical ecology appear somewhat different from those of temperate regions, but fundamentally they are similar. Superficially and practically they may seem different because the flora of the tropics, above all that of the humid forested regions, is immensely richer in species than that of the temperate zone, especially those parts of it which like Europe have been impoverished by glacial periods. This richness of the tropical flora has important consequences. Practically, it means that tropical plant communities generally have very numerous constituents which are difficult to recognize in the field and often poorly known taxonomically. A more important consequence, which bears directly on the chief aim of this symposium, is that in the tropics often, but not invariably, there tend to be innumerable slightly different combinations of species rather than the relatively few fairly well defined plant associations to which we are accustomed in Europe and North America. A further difference between the humid tropics and most temperate countries is that though, in the former, modification of the vegetation by human activities is almost universal and often very profound, there are large areas in which it is less severe or at least much more recent than in the latter. The apparent distinctness of many European and North American plant associations is probably often due to anthropogenic influences to which they often owe their sharp boundaries. One reason for the apparent lack of clearly recognizable plant associations in many parts of the tropics may thus be the comparatively low intensity and recent incidence of disturbance by man.

In dealing with the problems of classifying and naming tropical vegetation, reference is made specifically to two humid tropical regions, British Guiana in the northeast of South America and British West Africa. These two areas, though showing fairly comparable ranges of climate, are in a number of respects very different and may be regarded as exemplifying two extreme situations which may confront the student of tropical vegetation. The discussion is confined to the more humid types of forest — the tropical rain forest in the broadest sense of the term.

British Guiana is a country in which the great majority of the population, and nearly all the cultivated area, are concentrated in a narrow coastal strip; the interior extends for over 700 kilometers from the coast, but has a very sparse, mainly Amerindian, population or is quite uninhabited. The vegetation apart from the coastal strip is thus comparatively little affected by man and much of it consists of unmodified or only slightly modified climax communities. The area in the neighborhood of Moraballi Creek on the Essequibo river, which was studied by the author and his colleagues on the Oxford University Expedition to British Guiana in 1929, contained no grassland and was wholly forest-covered except for very small patches of shifting cultivation. Apart from this, which owing to the smallness of the population was relatively unimportant, the only human activity affecting the vegetation was timber working, consisting, at that time, of highly selective extraction of greenheart [*Ocotea rodiaei* (Schomb.) Mez] only. Where the forest showed no traces of former cultivation or of timber working it could be regarded as climax vegetation in equilibrium with the climate and had doubtless existed little changed from a fairly remote geological period.

As the area studied was not more than a few square kilometers in extent and had no striking topographical features, it could be assumed to have a uniform climate apart from very slight microclimatic differences. Differences between plant communities were not due to shift-

ing cultivation or timber felling, but must be due to other factors, presumably factors depending on topography such as drainage and exposure to wind or edaphic factors. This being so, it was surprising and not in accordance with the then accepted ideas about tropical vegetation, to find that both vegetation and soil were remarkably varied. Distinct and easily recognizable plant communities — referred to in 1929 by the non-commital term " forest types " — were found, and in many cases, though not always, the boundaries between one plant community and the next were sharp. Each " forest type " was associated with a distinct type of soil, or at least with a distinct combination of soil and topography.

Mr. T. A. W. Davis and the author have given a detailed descriptive account of the vegetation of Moraballi Creek in a paper published in the *Journal of Ecology* in 1933-34 and a much briefer account appeared in *The Tropical Rain Forest* (1952). It will be sufficient to say here that in addition to " Low Bush " (secondary forest on sites of former cultivation or timber felling, i. e. stages in secondary successions) there were five types of primary forest, Mora, Morabukea, Mixed, Greenheart and Wallaba. The Mora forest in which the Leguminous species *Mora excelsa* Benth, formed 67 percent [1] of the larger trees (41 centimeters and more in diameter) occurred on the most low-lying situations in the floodplain of the Moraballi Creek and occasionally ascended to higher levels on slopes where the bed rock was near the surface and the soil stony. Morabukea forest, in which another species of Mora, *M. gonggrijpii* (Kleinh.) Sandw., formed about 60 percent of the larger trees, occurred on better drained sites where the soil was a heavy and impervious reddish clay. Mixed forest in which the most abundant tree species were *Eschweilera sagotiana* Miers, *Licania venosa* Rusby and *Pentaclethra macroloba* (Willd.) Benth., but where there was no strong tendency to " single-species dominance ", occurred on light loamy soils with good drainage which could be regarded as the optimum habitat of the area. The two remaining " forest types, " that dominated by greenheart [*Ocotea rodiaei* (Schomb.) Mez] and the Wallaba forest in which *Eperua falcata* Aubl. (Soft Wallaba) formed some 67 percent of the larger trees, occurred respectively on brown sand and the peculiar strongly leached " white sand " which the author regards as the tropical lowland equivalent of a temperate podsol.

These five " forest types " form a series and were usually met with in the order given (Mora to Wallaba) if a transect were made from the river bank to the low plateaux and hill ridges which formed the highest ground in the Moraballi Creek area.

Floristically each " forest type " is distinct, though many species were common to all five of them; the composition of each was fairly constant and characteristic. The three central types of the series, Morabukea, Mixed and Greenheart were very similar in composition and there were very few if any species which occurred in one which were not found in all three, though the proportions in which the species were present were very different. The Mora forest and the Wallaba forest, the communities forming the two ends of the series, were strongly differentiated from the other types and each had a number of subordinate species peculiar to itself. There were some structural differences between the five communities in addition to their differences of composition, but they need not be discussed here.

Where the soil or topographic conditions characteristic of one forest type merged gradually into those characteristic of another, there was also a gradual transition from one community to the other, but where, as was the case particularly where the Greenheart and Wallaba forest adjoined, there was an abrupt change of soil conditions, the boundary between two communities could be very sharp.

There is an obvious similarity in the relationship between the Mixed forest with the Greenheart and Wallaba communities on the one hand, and with the Morabukea and Mora communities on the other, to the state of affairs in the " Mixed Mesophytic forest " of temperate North America where Dr. Lucy Braun has depicted an " undifferentiated " Mixed association flanked by " association segregates " with fewer dominants occupying steep slopes, outlying geographical areas and other situations where the conditions are presumably non-optimal for the majority of the species. In a similar way the Mora, Morabukea and Greenheart forest, and possibly even the Wallaba forest, could be regarded as " association segregates " of the Mixed forest. If a more orthodox terminology than Braun's is preferred, however, we can regard the Mixed forest as an association and the *Mora excelsa*, *Mora gonggrijpii*, *Ocotea* and *Eperua* communities as consociations, all five " forest types " being regarded as units of the same climax.

Since 1929, Fanshawe has made extensive studies of the vegetation of British Guiana which he has summarized in his valuable but unfortunately very brief *Vegetation of British Guiana: a Preliminary Review* (1952). This work helps us to see the plant communities of Moraballi Creek in a wider perspective. It also allows the five primary " forest types " to be put in their places in the classification of tropical American climax communities which was originally developed by Beard (1944; 1955) in Trinidad and which Fanshawe has adopted and extended on the basis of his experience in British Guiana. While the author is critical of some features of Beard's classification and would not wish to accept without question all the assumptions of which it is based, it is the most serviceable classification of tropical American vegetation types yet produced and it should be given an extensive trial until ultimately it can be improved or superseded.

[1] These figures and other data referring to floristic composition were obtained from single sample plots measuring 400 feet (122 m.) square (*c.* 1.5 ha.) in which all trees 4 inches (10 cm.) and over were counted.

According to Beard's scheme, as extended by Fanshawe, the Moraballi Creek forest communities belong to three different " formation series " as shown in the following Table:

TABLE 1. – DIFFERENT FORMATION SERIES TO WHICH BELONG THE MORABELLI CREEK COMMUNITIES

Davis and Richards' terminology	Unit	Formation	Formation-series
Morabukea consociation	*Mora gonggrijpii* faciation of Mixed rain forest	Rain forest	Rain forest
Mixed forest association	Mixed faciation of Mixed rain forest association		
Greenheart consociation	*Ocotea rodiaei* faciation of Mixed rain forest association		
Wallaba consociation	*Eperua-Eperua* association	Wallaba forest	Dry evergeen forest
Mora consociation	*Mora excelsa* consociation	Mora forest	Swamp forest

Thus in the British Guiana rain forest there are a number of clearly differentiated climax plant associations (Fanshawe has described many more than those mentioned here), which are readily recognized and defined. They could be mapped and their characteristics can be precisely stated. In the forests of British West Africa there is found a very different situation.

The five British West African territories, the Gambia, Sierra Leone, the Gold Coast, Nigeria and the British Cameroons (Trusteeship territory), are all strips of country of varying width and length extending inwards from the coast and they therefore consist of varying cross-sections of the vegetation belts which extend across the whole of West Africa from west to east. The conditions found in Nigeria and the Cameroons appear to be common to the Gold Coast and Sierra Leone.

On first acquaintance there seem to be certain great differences from British Guiana, though as has been said already, there is much similarity in range of climate between the two countries.

The humid forest zone of Nigeria (the equivalent of the *forêt dense* of Aubréville and other French writers) forms a belt parallel to the coast of the Gulf of Guinea. At its western extremity it is less than 100 kilometers wide (further west in Dahomey it disappears altogether), but it widens eastwards; in Nigeria west of the river Niger and in the Cameroons it extends some hundreds of kilometers from the coast. At its inland margin the forest belt is adjoined by the zone of Guinea savannas.

Perhaps the most important differences between this humid forest belt of Nigeria and that of British Guiana are those dependent on density of population. While the rain forest of British Guiana is almost uninhabited, the forest belt of Nigeria is densely populated and includes some of the most thickly populated areas of the whole country. Because this is so, it is not surprising that by far the largest proportion of the forest zone has become either permanent agricultural land (plantations of cocoa, oil palms, etc.), or is farmed under a system of cultivation locally known as the " bush-fallow ". Almost all the remaining forest is now enclosed in forest reserves under the protection of local or regional governments. Many of these reserves are being actively exploited for timber and it is only in the hilly country in the extreme east, bordering on the Cameroons, that there are considerable areas of forest which are not at present being exploited and are in a relatively undisturbed condition. In the smaller forest reserves of Western Nigeria, some fine fragments of forest still remain, but these are probably all old secondary communities, not relics of virgin forest. In the Okomu Forest Reserve, for example, Dr. E. W. Jones (1955) has shown that throughout the " high bush " there are fragments of pottery, charcoal, etc. in the soil which prove conclusively that the area was at one time cultivated and inhabited. The present forest dates from perhaps the eighteenth century when, for reasons which are not yet clear, the district became depopulated.

The dense population and consequent high degree of human interference in the Nigerian forest means that undisturbed climax forest is never met with, or very rarely; all stands of forest are a patchwork consisting of secondary communities of many different ages, i.e., a mosaic of seral stages. This state of affairs makes a formidable difficulty for the study of vegetation; in addition to the variation due to climate, soil and topography there is superimposed considerable variation depending on a time factor (which cannot easily be measured) and on the kind and intensity of human interference.

If allowance is made as far as possible for the effects of human interference, can distinct associations or other units of vegetation be recognized in the humid forest belt of Nigeria? It can be said at once that " forest types " as distinct as those met with in one area in British Guiana do not seem to exist in Nigeria, partly perhaps because there is less variety of soil, but some variation in the vegetation exists which can be correlated with differences of climate, and some (but of rather small importance) which seems to depend on soil; in addition there are differences between the composition of the forests in Eastern and Western Nigeria which may be due to historical factors and the geographical barrier of the river Niger.

The first distinction which was recognized in the Nigerian forest apart from that between the upland and lowland forests was that between the Evergreen forest and what earlier writers called Mixed Deciduous forest.

In the most humid parts of the forest belt, i.e., in those with the shortest and least severe dry season (in Nigeria, there is nowhere less than two consecutive months with under 10 centimeters rainfall), the forest is evergreen; though " tropical rain forest " in the broad sense of the term, it approximates physiognomically to what Beard calls evergreen seasonal forest in tropical America. Towards its inland boundary this forest becomes more or less gradually different in floristic composition though not fundamentally different in structure or physiognomy except for the greater proportion of trees deciduous for a considerable period. This forest is the Mixed Deciduous forest (*forêts tropophiles* or *semi-caducifoliées* of French and Belgian authors). The change from Evergreen to Mixed Deciduous forest coincides with a slight change of climate and also with a change in the soil-forming material from sedimentary to crystalline rock. Some recent writers have argued that Mixed Deciduous forest is heterogeneous, that it is not climatically determined but dependent on the substratum and that the name is misleading or inappropriate. More recent studies in Nigeria, in 1955, caused one to revert to the older opinion that there is a distinctive forest type, determined mainly by climate, for which the name Mixed Deciduous forest is at least as good as any other which has been suggested.

When we try to make further distinctions, e.g., to recognize different associations, faciations or other units within the Evergreen or the Mixed Deciduous forest, inadequate data and the fragmented state of the remaining forest present formidable difficulties. Rosevear (1953) has suggested very tentatively that there are four types of lowland rain forest in Nigeria, characteristic of Ondo Province, Ijebu Province and Benin Province in Western Nigeria, and of the Eastern Provinces respectively. Rosevear's Ondo type largely corresponds with what is here referred to as Mixed Deciduous forest. The other three types are variants of Evergreen forest; to what extent the differences are due to climatic factors, edaphic factors or to geographical barriers remains to be determined. It seems probable that the marked differences between the Western and Eastern forests are due largely to historical factors and the geographical barrier formed by the Niger and Cross rivers, but whether climatic differences are also important is uncertain. The differences between the Ijebu and Benin forests are perhaps dependent on differences of soil. To what extent these two types represent stages in a single continuum is difficult to determine when so much of the forest of the intervening region has been destroyed.

The study of tropical vegetation raises problems of classification and nomenclature. The aim of ecology (in its synecological or phytosociological aspect) in the tropics as in other parts of the world, is to describe, name and classify plant communities, not simply for classification's sake, but in order to bring to light causal relations between the vegetation on the one hand, the environment on the other. This should lead to the clarification of what Emberger terms *homoecies* (perhaps best rendered in English as " equivalent environments "); this, apart from its great scientific importance, is of great potential value for agriculture, forestry and land usage generally. The comparison of British Guiana with British West Africa may at least indicate how much remains to be done and some of the difficulties which will have to be surmounted before such aims can be realised in the humid tropics.

As is well known, there is no general agreement as to how temperate plant communities should be classified and named. It is not to be expected that agreement should be reached any more easily for the highly complex plant communities of the tropics. The first constructive suggestion to make is that even more important than an agreed scheme of classification and nomenclature is some measure of standardization in methods of describing and sampling vegetation units. A natural classification of any set of natural phenomena presupposes a fairly complete knowledge of the facts on which the classification can be based. With tropical vegetation such knowledge is far from complete. In 1939, the late Professor Tansley, Dr. A. S. Watt and the author published a scheme for *The Recording of Structure, Life-form and Flora of Tropical Forest Communities as a Basis for their Classification.* This scheme was intended to give foresters and others working in the tropics some guidance in collecting descriptive data about tropical vegetation. It seems to have proved useful and a new version, brought up to date and perhaps extended to include communities other than forest communities might be even more useful and would perhaps help towards the objects in view.

Secondly, there are several fairly complete schemes of classification of tropical vegetation in existence; all of these have their shortcomings and all are intended by their authors to apply to one region of the tropics alone. There are, for example, Beard's scheme for the vegetation of tropical America which has already been mentioned and Professor van Steenis' very valuable classification of the vegetation types of Malaysia. For India and Ceylon there is Professor Champion's elaborate classification of the forest types of India and Burma. Though premature attempts to equate plant communities in one part of the world with those in other very distant parts are to be avoided, it might be well worth while for those with the right experience to compare these schemes. It might then be worth examining how far Beard's scheme could be applied to Africa and Asia or Champion's to Africa and tropical America. But in doing this the question should not be that of pure classification and nomenclature but rather the tracing of causal relations between the vegetation and the factors which determine it.

References

Beard, J. S. (1944) - Climax vegetation in tropical America. *Ecology, Vol. 25*: 127-158.

——— (1955) - The classification of tropical American vegetation-types. *Ecology, Vol. 36*: 89-100.

CHAMPION, H. G. (1936) - A preliminary survey of the forest types of India and Burma. *Indian For. Rec.* (New series), *Vol. 1*, No. 1.

DAVIS, T. A. W. and RICHARDS, P. W. (1933-34) - The vegetation of Moraballi Creek, British Guiana: an ecological study of a limited area of tropical rain forest. Parts I and II. *J. Ecol. Vol. 21*: 350-84, *Vol. 22*: 106-55.

FANSHAWE, D. B. (1952) - The vegetation of British Guiana: a preliminary review. *Imperial Forestry Institute, Oxford, Institute Paper No. 29.*

RICHARDS, P. W. (1952) - *The tropical rain forest, an ecological study*, Cambridge.

——, TANSLEY, A. G. and WATT, A. S. (1939) - The recording of structure, life-form and flora of tropical forest communities as a basis for their classification. *Imperial Forestry Institute, Oxford, Institute Paper No. 19* (also printed in *J. Ecol. Vol. 28*: 224-239, 1940).

ROSEVEAR, D. R. (1953) - Chapter XV, Vegetation, in the *Nigeria Handbook*, London.

STEENIS, C. G. G. J. VAN (1935) - Maleische vegetatie schetsen. (AN OUTLINE IN MALAYSIAN VEGETATION) *Tijdschr. ned. aardrijksk. Genoot.* (PERIODICAL OF THE NETHERLANDS GEOGRAPHICAL SOCIETY) *Reeks* (SERIES) *2*, 52: 25-67, 171-203, 363-98

LIST OF SCIENTIFIC COMMUNICATIONS IN ORDER OF PRESENTATION

		UNESCO NS/HT/46
G.S. PURI (India)	Problems in the Ecology of the Humid Tropics	Annexe 1
A. DILMY and A.J. G.H. KOSTERMANS (Indonesia)	Research on the Vegetation of Indonesia	Annexe 2
R.A. de ROSAYRO (Ceylon)	Tropical Ecological Studies in Ceylon	Annexe 3
J. WYATT-SMITH (Malaya)	A Note on the Study of Tropical Vegetation	Annexe 4
P.W. RICHARDS (U. K.)	The Study of Tropical Vegetation with special reference to British Guiana and British West Africa	Annexe 5
P.W. BEDARD (U.S.A.)	Reconnaissance Classification and Mapping of Philippine Forests	Annexe 6
F.R. FOSBERG (U.S.A.)	Vegetation of the Islands of Oceania	Annexe 7
D. CHATTERJEE (India)	Tropical Vegetation of Eastern India	Annexe 8
C.G.G.J. VAN STEENIS (Netherlands)	Concise Outline of Malaysian Vegetation Mapping and Literature	Annexe 9
R. MISRA (India)	The Study of Tropical Vegetation in Madhya Pradesh and the Gangetic Valley	Annexe 10
J.W. PURSEGLOVE (Singapore)	The Vegetation of Humid Tropics with special reference to Singapore	Annexe 11
F.R. BHARUCHA (India)	Methods for the Study of Tropical Vegetation	Annexe 12
C.H. MACFADDEN (Ceylon)	Humid Tropical Vegetation Research by Aero-Field Techniques and Photography	Annexe 13
C.H. HOMES (Ceylon)	The Broad Pattern of Climate and Vegetational Distribution in Ceylon	Annexe 14
G. MANGENOT (France)	Les recherches sur la végétation dans les régions tropicales humides de l'Afrique occidentale	Annexe 15
B.W. TAYLOR and G.A. STEWART (Australia)	Vegetation Mapping in the Territories of Papua and New Guinea conducted by CSIRO	Annexe 16
E.K. JANAKI AMMAL (India)	An Introduction to the Genetical Analysis of the Humid Forest Flora of South Asia	Annexe 17
S. HEDAYETULLAH (Pakistan)	The Study of Tropical Vegetation with particular reference to Pakistan	Annexe 18

Copies of all the papers can be obtained from UNESCO, South Asia Science Co-operation Office, New Delhi, India.

Control of Brush and Undesirable Trees: III

by Arthur W. Sampson, Professor of Forestry Emeritus,
and Arnold M. Schultz, Associate Specialist, School of Forestry, University of California

This article represents the third section of a paper which has been prepared at the request of FAO. Earlier sections appeared in Unasylva *Vol. 10, Nos. 1 and 3. The concluding section will appear in Vol. 11, No. 1. The whole series will then be made available under a separate cover.*

Methods and Equipment for Controlled Burning

Controlled burning is the planned application and confinement of fire to a preselected area, usually on "wild lands." The actual burning may be done in a number of ways, varying from prescribed burns in which a narrow range of weather and fuel conditions are needed to accomplish a particular objective, to "convenience fires" in which the only predetermined elements are time and place of burn (*34*).[1]

As a rule, fires burn better and kill more plants when temperatures are high, humidity low, and where there is some wind movement. At such times, hazards are great and control is difficult. The objective of controlled burning is to obtain as effective a burn as possible under the safest conditions.

Steps carried out in this method of brush control are locating the limits of the area to be burned, preparing the control lines, preparing the fuel, and conducting the burn.

Locating and preparing control lines

The area to be burned must be bounded by natural or artificially prepared barriers. These serve simultaneously as points from which the fire is ignited and as barriers to its uncontrolled spread. Whenever possible, natural barriers should be used as control lines: they are often wider and more effective, and their only expense involves taking a little more area into the burn or leaving some out. They can be classed as physical (recent burns, streams or roads, rock ledges), topographic (ridge tops, wide ravine bottoms), and fuel-type barriers (sparse vegetation, green grass, mesic brush types on north-facing slopes). The safest control lines are combinations of these, as a road running through green grass near a ridge top (*4*).

Artificially constructed control lines must take topography and fuel-type into consideration in order to stop surface, crown and spot fires. Surface fires are stopped by interrupting the continuity of the surface fuel. The line need not be wide but it should be bared to the mineral soil. A good rule to follow is to make the line at least as wide as the standing height of the fuel adjacent to it. Thus, in grass the fire line need not be as wide as in tall dense brush. Under conditions favorable for prescribed burning in forests, a narrow line through the needles made with a hand rake is adequate. This means that, in order to prepare lines as cheaply as possible, the boundary of the control burn should be dropped back into grass or cultivated land at the edge of the brush or under trees where there is no heavy debris or standing brush in the understory.

Crown fires are stopped by clearing a wide space through the brush or tree canopy. The width of this space depends on the amount of heat developed at the edge of the burn, the direction and strength of the wind across the line, and the flammability of the fuel on the outside of the line.

Spot fires are difficult to stop but they can be reduced by avoiding the inclusion near the line of shrubs and trees which explode flaming leaves high into the air, and by locating the control lines where wind movement can be predicted most accurately.

The area to be burned should always lie up-slope from the control line (Figure 40). Lines should never be located part way up the slope or on ridgetops; rather they should be placed immediately over the ridge on the side opposite the burn.

The position of the control line must also be placed where ignition is easy. The ease of ignition, or firing, is inversely related to the size, moisture content, and sparsity of the fuel, and directly with the wind velocity, air temperature and dryness, and steepness of slope. The most important criterion for a good firing line is a light, dry, and continuous fuel for some distance inside the boundary and continuing into the brush to be burned. The firing can be done rapidly; there is little heat next to the line, and a particular segment of the line need not be held for any length of time. Examples of such fuels are dry grass, leaf litter, pine needles, and light brush which has been mashed down with a bulldozer.

Mechanical equipment which can be used to prepare fire lines has already been described. In heavy brush

[1] The references to literature cited were given in Unasylva Vol. 10, No. 1. with the first part of this paper.

or flammable trees, the bulldozer is used to clear a path wide enough to meet safety specifications. The broken stems are pushed inside the line — never outside. If a considerable length of time is to elapse between the time of preparing the control line and the controlled burn, it is best to move all the bulldozed material far into the brush at intervals along the periphery. Punky wood such as wood-rats' nests and rotten logs should also be pushed well inside of the line. Tall snags should be pushed over with a bulldozer as they burn for a long time, throwing sparks for considerable distances. If the brush stand is not too dense, a strip the width of one or two dozer blades can be mashed directly inside the control line to make firing easier.

Where the control lines are laid out in grassland, a disc is used to provide a barrier of mineral soil. This may be done while the grass is green or when the soil has sufficient moisture for easy tilling. The same effect can be obtained by scraping the grass off with a bulldozer or road grader. Often an adequate line can be made with a shovel or hoe.

In pine needles a rake or McLeod fire tool, which is a combination hoe-and-rake, is a most useful device. Pine needles and duff should be removed to mineral soil and heaped up or spread on the inside (side to be burned) of the line. The same tool can later be used for igniting the fire — by dragging a rake-full of burning needles.

Another means of preparing fire lines combines mechanical or chemical methods with pre-burning. A strip of brush is mashed with a bulldozer or sprayed with a quick-acting desiccant. When the fuel moisture has been sufficiently reduced, it can be ignited with but little danger of burning the green, untreated brush adjacent to the strip (Figure 41). Pre-burning is also used to prepare wide lines running through grass; firing may be done late in the evening when the humidity is high enough to insure safe burning. Pre-burning consumes the fine, dry fuel, precluding hazard later, but the fire may not be intense enough to kill brush plants.

Igniting and conducting the burn

Setting the fire around the periphery of an area to be burned in the conventional way is a procedure requiring care and patience. Since the entire operation is slow, no speedy or complicated devices are needed for ignition. A few simple methods are described briefly.

Throwing lighted matches into the dry fuel along the edge of the control line is a method which obviously requires no equipment. However, a light McLeod tool is handy and easy to carry; one of these should always be available in case of spot fires or fire over the line.

FIGURE 40. *Control line along road near foot of slope. Note wide band of grass between road and brush.*

FIGURE 41. *Roadway, the original control line, has been widened by pre-burning a band of mashed brush at such a time when the unmashed brush was too green to burn.*

FIGURE 42. *Ignition of dry, mashed brush with drip torch. The can holds enough diesel oil for an hour of intermittent dripping.*

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FIGURE 43. *Pneumatic back pack flame thrower. This unit holds about 3 gallons (11.5 liters) of diesel fuel. It will throw a flame up to 20 feet (6.1 m.) under 80 to 100 pounds (5.6-7 kg. per cm²) of pressure, using fuel at the rate of 0.4 gallons (1.5 liters) per minute. The entire unit weighs less than 100 pounds (45 kg.).*

U.S. Forest Service

It can be used to "drag fire" by passing a flaming tuft of fuel slowly through the grass. An old tire casing partially filled with crank case oil aflame can be towed through the dry grass. The drip torch produces the same effect. This is a gallon can containing Diesel oil. It has a wick at the end of a long spout. The wick, saturated with the oil, is lit and when the can is tilted, oil drips through the wick and is burning as it drops out on the fuel (Figure 42). While these rustic methods are useful in dry grass and pine needles, they are unsatisfactory wherever the fuel structure is not of low stature nor compact, as is found in a dense growth of standing brush. Here a portable, pneumatic flame thrower is necessary to create enough heat to ignite the loosely arranged stems (Figure 43). The flame thrower, like the drip torch, burns Diesel fuel. This is held in the can under high pressure, and may be ejected as a hot flame 20 feet or more. The oil is ignited as it passes through the nozzle over a burning wick.

Three general plans for firing have been used. The simplest and most common is edge firing (Figure 44, left). Fires are started along control lines and allowed to burn to the center. This procedure is the safest plan, especially in dense brush where there are no escape trails out to the control line. The entire area should be so situated that air movement will be into the burn as firing is done along the periphery. There must be enough dry fuel in a uniform, continuous pattern to carry the fire to all the undesirable plants. The area must be small or compact enough to be burned over during the short period of the day when temperature, humidity, and wind are fairly constant.

In "center" firing the first fires are started in the center of the area and allowed to spread until a large quantity of heat is generated (Figure 44, center). Then other fires are set near the periphery. These are drawn toward the center fire by in-draft of air, creating winds up to 10 miles (16 km.) per hour from all sides. The center fires themselves are stabilized and rarely burn out toward the edge. This method is limited to small areas of level terrain and free from wind movement.

Strip firing can be used on slopes or where prevailing winds will cause fire to burn in one direction. First a narrow strip is burned by setting a line of fires a little way downslope from the leeward edge of the area (Figure 44, right). When that fire is burned out, another strip is started about 100 feet farther in or down-slope. Each successive strip can safely be wider than the last since the firebreak ahead is wider. This method is advantageous where an edge-set fire would be difficult to ignite or if allowed to burn briskly might burn back across the control line.

The foregoing discussion has described conventional "broadcast" burning methods (Figure 45). Success of such fires is variable. Ordinarily a controlled burn is planned far in advance for a particular date. Control lines have been installed, a crew of men must be on hand (Figure 46), and grazing has been deferred

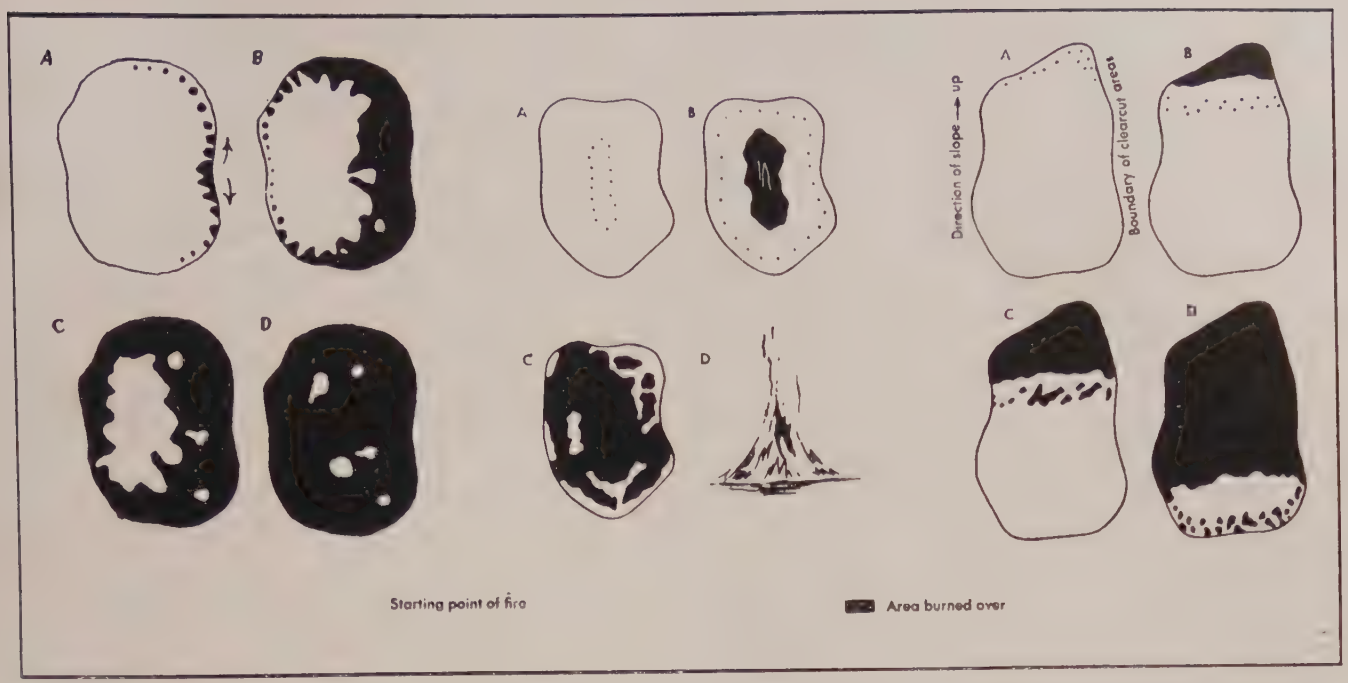


FIGURE 44. *Diagrams of three conventional firing plans.* **Left:** *Edge firing.* A - *Two crews start at point of arrows, lighting fires around the periphery.* B - *Firing completed, right side fires have coalesced and burned far inward.* C - *Fire coming together from all sides.* D - *Burn completed.* **Middle:** *Center firing.* A - *First fires started in center of the area.* B - *The center fires have united and a second series of fires has been started along the edge.* C - *Inner and outer fires beginning to merge, and spreading out to edge of area.* D - *Cross-section of* C *showing flame drawn toward center.* **Right:** *Strip firing.* A - *First fires lit near the extreme upper edge of slope.* B - *Upper edge burned cut and another strip of fires started 50 feet down-slope.* C - *Second strip burned out, another started.* D - *Final strip of fires started along lower edge.*
Adapted from Arnold, Burcham, Fenner, and Grah (4)

so that there will be a heavier grass fuel to carry the fire. Slight changes in weather, too subtle to warrant calling off the burn for that day, may be effective enough so that only the grass is burned, thus wasting the whole year's efforts. Recent trends have been to mash the brush a year in advance so that the stems and leaves will be dry and compacted near the ground, and grass will have grown up through the dead limbs. Even on a relatively cool day, fires will consume most of this kind of fuel. This combination of mechanical treatment and fire is highly effective in many localities.

It has been found that in order to achieve a clean burn it is not necessary to mash all of the brush. The brush may be bulldozed in any of several different patterns, alternately mashing and leaving unmashed strips, so that only one-half or one-third of the area is treated, thereby cutting down the cost proportionately.

A fourth firing plan, called "area ignition," may be used to burn brush fields thus prepared after the mashed strips have dried. It involves the distribution of a large number of individual fires over an area in a short space of time (*4*). The fires are so closely spaced that the heat radiated from one causes the others to burn more intensely, and the fuels in between are dried and heated so that they burn more rapidly. The many flames coalesce into one intense fire-storm whose strong indraft keeps the fire from running. In practice, this is effected by a crew of men (Figure 47), each equipped

FIGURE 45. *Controlled burn ignited by edge method. Sierra-Nevada mountain foothills, California. The tall trees are digger pine, a worthless species on range land.*
University of California

FIGURE 46. *Crew and equipment assembled for a controlled burn in California, August 1952. On this fire of 820 acres (332 ha.), 98 men were on the firelines; 17 women prepared and delivered lunch and refreshments. Equipment consisted of 3 jeep tankers, one jeep with Bean sprayer, 4 four-wheel drive truck tankers, one truck with 300 gallons (1,140 liters) water tank, and two jeeps used for patrolling. In addition there were enough McLeod tools and back pumps for everybody.*

University of California

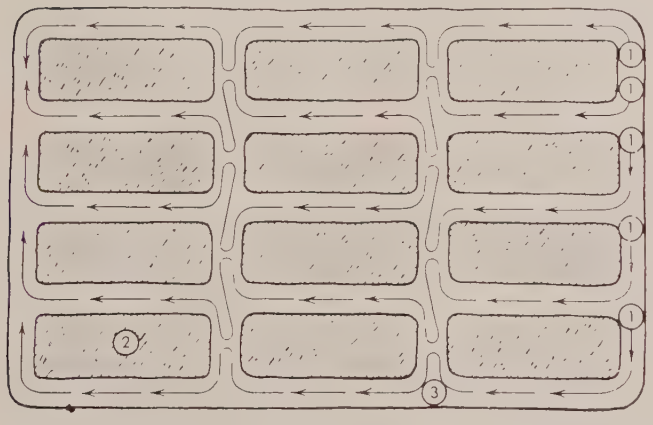


FIGURE 47. *Diagram of plan for area ignition. Brush has been prepared for burning by mashing strips with a bulldozer several weeks in advance of controlled burn (3). Blocks of standing brush (2) are about twice the width of the mashed strips. A crew of 5 men travel along the routes indicated (1), firing the dry brush with drip torches as they go.*

After Arnold, Burcham, Fenner, and Grah (*4*)

with a drip torch, quickly lighting fires as they move down the parallel aisles of mashed brush. They must try to keep abreast of each other so as not to endanger any one who may lag. If the crew travels at about 2 or 3 miles per hour (3.2 to 4.8 km/ph.), and the fuel is at the desirable moisture content, the brush will be ignited at the speed needed to make a safe and effective burn. The intensity of the fire can be controlled by increasing or slowing the rate of firing.

The heat generated by area ignition is intense enough to consume the green, standing brush between the mashed strips. The method can most safely be used during spring months when wood is moist and hard to ignite (Figure 48). It can also be used to burn out wide control lines before the conventional broadcast burn is conducted.

Special equipment for ignition

The use of pyrotechnics in controlled burning is a new field of research. A number of devices have been tested for igniting fuels but as yet there is little to report concerning advantages of one method over another, their comparative effectiveness, or the differential in cost.

The devices include a variety of grenades which can be thrown by hand, shot out from a gun barrel, dropped from planes, or strategically placed on the ground and fired by electrical circuits or by fast fuse (Figure 49). One method which has been tested in the chaparral of California consists of spacing grenades at intervals of 50 or 100 feet (15 to 30 m.); the grenades are nested in fuel accumulations made by cutting and piling brush and are fired simultaneously. In another method good results are obtained when grenades are dropped from a slowly moving plane (90 m.p.h. or 144 km/ph.) flying at an altitude of about 500 feet (150 m.). When a continuous compact fuel is on the ground, such as dry grass, small or large and individual or clustered grenades are equally efficient in starting fires.

The advantage of using pyrotechnic devices is that it facilitates burning out wide strips of brush which are practically inaccessible on foot with flame throwers and other pieces of conventional equipment. This may be in areas of rugged terrain or in the center of controlled burns which have been fired along the edge. There is no danger of crews being trapped by fire when the grenades are laid in advance and connected by a long fuse. The simultaneousness of firing accomplishes the same effect as area ignition when the grenades are laid out in a suitable pattern. Hence this method may be used effectively for winter and spring burning to improve game ranges or for construction of wide fire control lines.

FIGURE 48. *Comparison of results from area ignition and conventional methods of firing. The area in foreground was burned by area ignition after 40 percent of the brush was mashed. Under the same weather conditions standing brush in background did not burn when fired by edge method.*

U.S. Forest Service

Prescribed burning in forests

Prescribed burning has been defined as the planned application and confinement of fire to an area to accomplish a particular objective. The chief objectives in forests are to:

1. reduce fire hazard by removing brush and woody debris;
2. prevent the invasion of inferior species in the understory;
3. reduce growth stagnation in stands of dense reproduction;
4. prepare ash seedbeds for natural reproduction of desirable trees;
5. reduce the amount of unnecessary litter and vegetation that intercepts precipitation and renders it unavailable to tree growth and/or ground water supply;
6. reduce the incidence of fungal diseases and insect attacks;
7. improve range land for cattle grazing;
8. improve habitat for game and facilitate its harvest.

No special equipment is needed for such burning. The important requirements are favorable weather and fuel. Although the technique varies from place to place, the following principles are involved. Fires under conditions of low humidity and high temperatures may kill any tree. Wet or cold season burning when the fuel is dry and trees dormant is the safest practice. Many of the broadleaved shrubs and trees are thin-barked and easily killed by light fires; on the other hand many of the most valuable trees for lumber are remarkably resistant to fire; examples are longleaf, slash, and loblolly pine in southeastern United States and ponderosa and sugar pine in western United States. The fire-tolerant species are usually the dominants of sub-climax plant communities, having developed in an environment where fires were natural and frequent in occurrence (*43*).

The fuel to carry fire to the brush and debris may be grass, as in southeastern United States, or the needles of the forest trees. Fires should be kept low on the ground at all times and special preparation of the fuel structure will be necessary in some cases. Burning uphill may start crown fires. Snags, punky logs, and cat-face trees should be treated with proper caution.

Costs of controlled burning

Costs are variable from place to place depending on wages, availability of equipment and kind of vegetation, and from year to year, depending mainly on the progress in developing techniques that make a suitable compromise between safety and effectiveness of burns. The source of most available data on burning costs is in California, where burning of brushlands under permit was legalized in 1945 and where research and practice have made great strides since then.

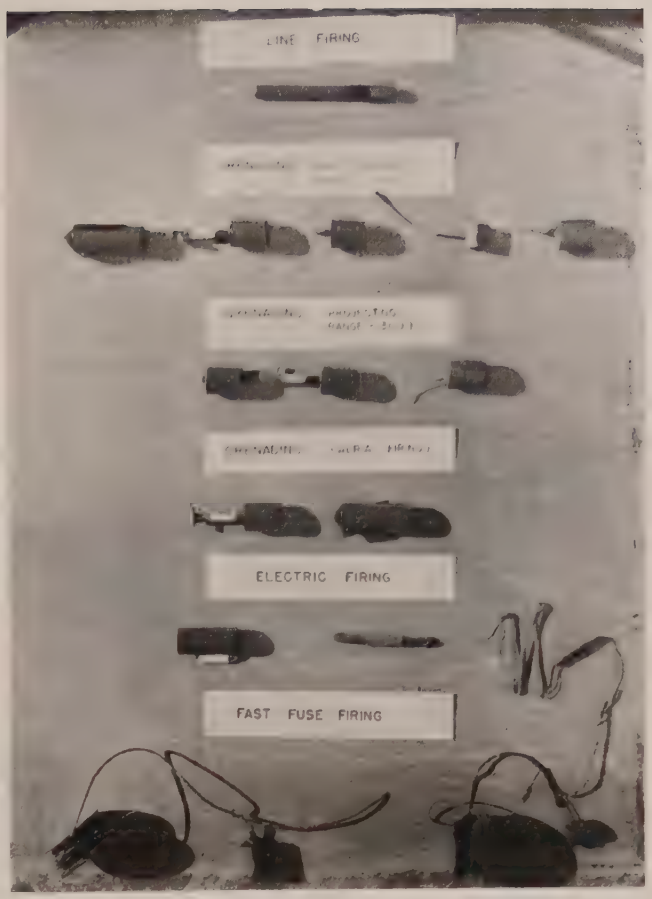


FIGURE 49. *Devices used for rapid ignition. Made by Fenner and Day, Richmond, California.*
Ralph L. Fenner

Costs of burning under permit has two components: costs to the permittee or land owner and costs to the State or local government (*34*). Examples of these costs are as follows:

Costs to Permittee	*Costs to State*
1. Preparation of control lines.	1. Time required by administrative personnel in technical advice and inspection of control.
2. Other protective measures.	2. Equipment and expenses for stand-by service to protect adjacent property.
3. Labor, equipment, and food incident to execution of the burn.	3. Time of stand-by crews.

Permittee costs not considered are the loss of grass as fuel which could be used as forage, and the consequent rental of supplemental lands or purchase of additional stock feed to compensate for that sacrifice. Subsequent management costs, such as reseeding and fencing, are

also not included. The state costs are not a contribution to the permittee, in the sense that a profit may accrue to his benefit. Rather, they are accounting charges stemming from the administration and regulation of the use of fire in range improvement for the protection of the public interest.

The two most important factors in determining the cost per acre are size of burn and extent of preliminary treatment. In size of burn the largest component of cost is in assuring safety, namely, constructing the control lines. In preliminary treatment the cost is for assuring effectiveness.

Figure 50 shows the relation between size of burn and cost per acre for controlled burns conducted in northern California in 1947 and 1948. For burns 640 acres (260 ha.) or less in size, total costs have been broken down into permittee and state costs. Although not included on the graph, costs per acre for representative burns of larger sizes have the following trends: for areas over 700 acres (283 ha.), costs decrease from \$1.20 to about \$0.40 until a size between 5,000 to 10,000 acres (2,024 to 4,047 ha.) is reached; beyond that point, costs per acre increase somewhat again. The initial drop in the curve results from the fact that there are certain basic costs which occur no matter how many acres are in the burn. Beyond 440 acres (178 ha.), larger equipment is needed and more elaborate protective measures must be provided, but on a cost per acre basis,

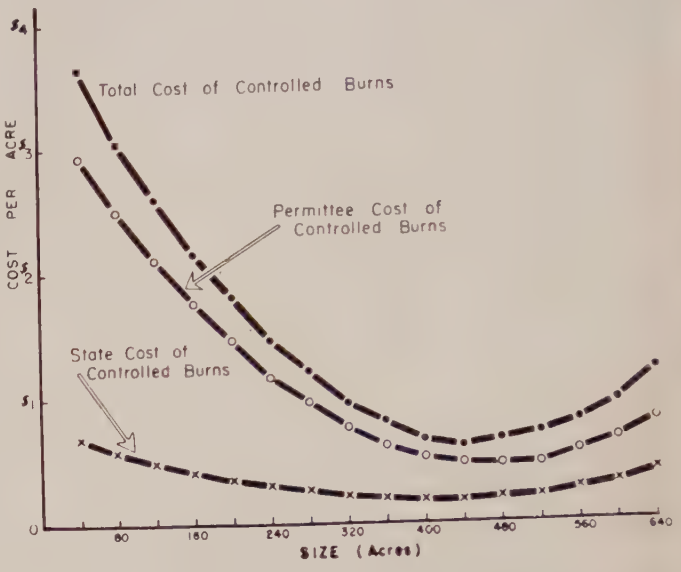


FIGURE 50. *Curves showing how cost per acre for controlled burning depends on size of burn, up to 640 acres (260 ha.). Minimum costs are at 440 acres (178 ha.).*

After Sampson and Burcham (34)

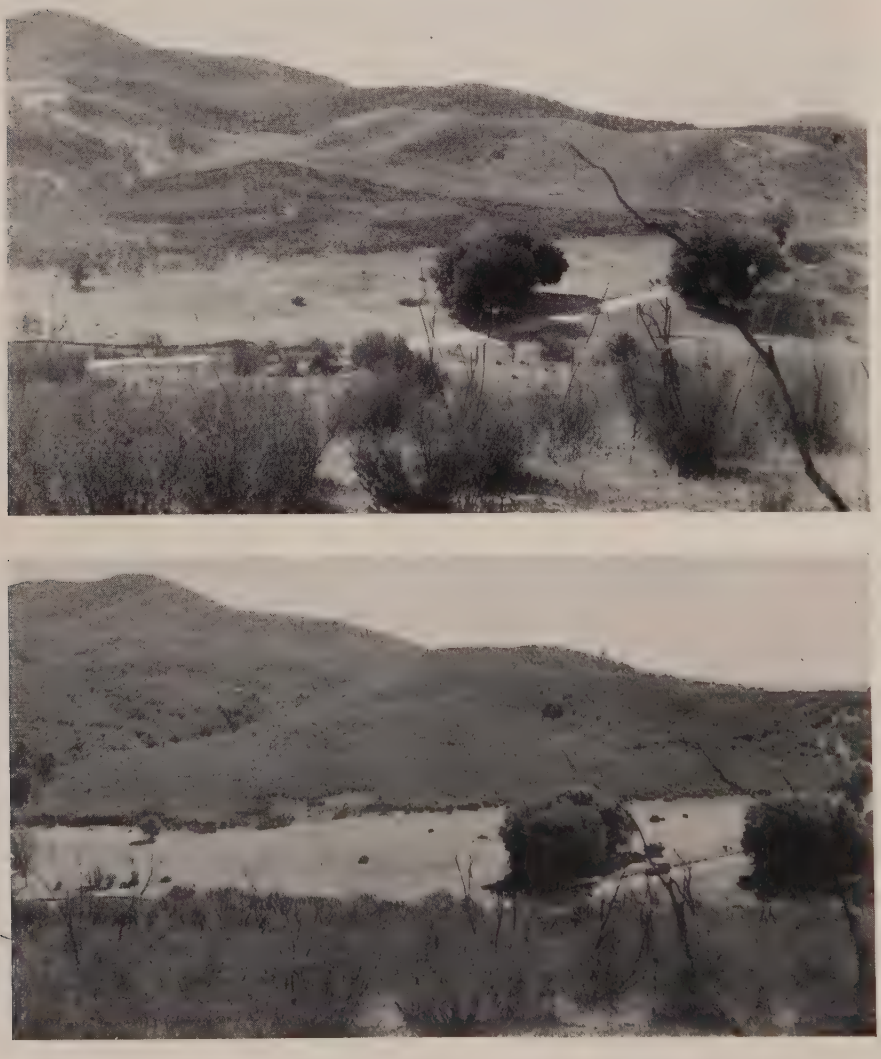


FIGURE 51. *Chamise field in California before and after burning. The photograph (above left) was taken before any treatment. Then the strip in the center was mashed with bulldozer and allowed to dry 10 months. The slope in left center of lower photograph was burned standing: islands were left unburned and nearly all of the plants have resprouted. The mashed strip burned clean and the fire was intense enough to kill a large proportion of the plants completely, thus reducing the amount of sprouting. Slope in background was not burned.*

California Division of Forestry

the high point is reached at about 700 acres (283 ha.). The burns of big acreage again need larger equipment and more men, and different techniques must be employed to obtain safety.

TABLE 1. – FACTORS AFFECTING COSTS OF CONTROLLED BURNING

Brush condition	Brush density	Percentage of area to be mashed
Young, brush growing vigorously, few dead twigs and leaves, litter on ground will not carry fire	Open-brush crowns with 20-50 % density	100
	Medium - 50-80 % density	100
	Dense - 80 % density	100-50
Mature brush plants which have attained maximum height, visible dead twigs and branches in crown, litter on ground enough to carry fire under normal burning conditions in summer	Open	100
	Medium	50
	Dense	33
Over-mature plants with crowns beginning to thin, many dead twigs and branches, litter on ground will carry fire whenever it can be ignited	Open	100
	Medium	33
	Dense	25

From the information given in Table 1 the approximate relative costs for burning can be ascertained.

The amount of mechanical or chemical treatment needed prior to a burn is decided by the intensity and cleanness of burn desired. Edge firing around an area of standing brush may result in low brush kill percentages and little consumption of fuel while railing or mashing of the brush before a clean burn can be assured (Figure 51). The proportion of area that may be treated is shown summarily in Figure 52. Experimental area ignition tests in chamise and mixed chaparral types, where the average diameter of main stems is 1 to 4 inches (2.5 to 10 cm.), indicate the following rough guide for brush mashing (*14*).

FIGURE 52. *Experimental photo for area ignition tests.*
(a) *50 percent mashed - strips of mashed and unmashed of equal width;*
(b) *33 percent - unmashed strip two dozer-widths across;*
(c) *25 percent - unmashed strip 3 dozer-widths;*
(d) *50 percent mashed in gridiron pattern;*
(e) *100 percent mashed;*
(f) *untreated brush.*

U.S. Forest Service

Methods and Equipment for Chemical Control of Brush

The use of chemicals for brush control is not new. Such household materials as kerosene, table salt and arsenic have long been used to kill plants. Yet no large scale efforts were made to control brush and undesirable trees with chemicals until compounds were developed which were specific for this purpose. Chemical brush killers are now the basis of a great research effort and a large industry. Several factors are responsible for this recent progress: the demand for a safe, sure, and cheap method of eradicating undesirable plants; advanced knowledge of basic physiological activities in plants; and the profit motive of chemical manufacturers.

Advantages of chemical control are that complete kills of plants are obtained more easily than with mechanical grubbing methods, and that ordinarily few hazards are involved. Disadvantages are that much research or trial-and-error is needed to learn of the right chemical, the dosage, and the proper timing of application for each species, and that, after a plant is killed, the entire woody portion remains erect and intact. Moreover, the chemical frequently renders the wood less susceptible to rotting. Because the chemical method kills but does not remove the brush, combinations of either mechanical equipment or fire are generally also employed.

KIND OF CHEMICAL

In order to understand why certain methods of application should be used it is important to know the action of the common herbicides. To be effective as a brush killer, a chemical should have the properties of being readily absorbed by plant tissues, being translocated within the plant, and killing the cells or tissues and eventually the plant. Of these, translocation is not an absolute necessity. A brief discussion of the physio-

logical activity of some of the commonly used chemicals follows. Certain chemicals may fall under more than one of the categories of the classification.

Selective or hormone-type herbicides

These are so-called growth-regulating chemicals which are translocatable within the plant and act basically on the enzyme systems. Enzyme systems vary in chemical structure from one plant group to another, so that a particular hormone-like compound reacts specifically to the protoplasm of a certain genus, species, or perhaps a strain. This is the basis of the selectivity. In a heterogeneous brush stand, composed of a dozen or more species, the herbicide will affect the growth rate or respiration rate of some shrubs, but may have minor or no effects on others. This is an advantage only where the undesirable species are susceptible, but where certain components are to be maintained for browse.

Many herbicides of the hormone-type have been formulated but only two are well known — 2,4-D and 2,4,5-T. They have been widely used on brush species, and with varying success. In order to reduce the selective action, the two chemicals are frequently mixed, thus being effective on a greater number of species.

Either 2,4-D or 2,4,5-T can be applied in the ester, amine salt, or acid form. Of these, the esters are most soluble in oil and because of this they are the most readily absorbed by the oily or waxy cuticles which are common to leaves of many brush plants, especially those of the Mediterranean climates. Next to the esters, free acid formulations are absorbed better by leaves than are the water-soluble amine salts. However, once the chemical is through the epidermis, it must be dissolved in the water of the mesophyll in order to enter the phloem and take action in the meristematic cells. Now the amine form functions best, while the esters are least readily translocated. Thus it can be seen how the nature of the cuticle and leaf tissues within a species can determine whether esters or amines of 2,4-D or 2,4,5-T will be the more effective chemical to use.

One of the serious disadvantages of using ester forms of either 2,4-D or 2,4,5-T is the high volatility. Evaporation of the chemical from the sprayed foliage may occur for some time after spraying, and may affect neighboring vegetation. This is not to be confused with the "drift" that occurs during the act of spraying, which may be as bad with acids or amines as with esters.

2,4-D and 2,4,5-T have several advantages over many of the other chemicals to be discussed. These include the following: they are not poisonous to livestock; they are non-corrosive to metal parts of equipment; a relatively small amount of undiluted chemical is needed — usually about 1 to 4 pounds per acre (1.13 to 4.5 kg. per ha.) and they are effective under a wide range of volumes making them equally adapted to airplane, ground-rig, or hand application. Since grasses are not affected, these selective compounds are popularly used for brush control on range lands.

Disadvantages are the close dependence of effectiveness on concentration, growth stage of plant, weather and soil conditions, and the tendency to drift. Either aircraft or ground-rig application may result in a spreading of particles for miles around, culminating in the loss of valuable crops. Aircraft application is bad even on still days due to the turbulence set up by the propeller.

Non-selective contact herbicides

There are many water-soluble chemicals which are translocated but not selective. They can be used either as foliage sprays or applied to cut surfaces. The better known of this group are ammate (ammonium sulphamate) and sodium arsenite, although a number of chlorate and thyocyanate compounds have the same action. Being water soluble, they can be translocated to various organs of the plant when they reach phloem elements. Plant cells which have prolonged contact with the compounds are killed. The effect is about the same on the protoplasm of any plant but rate of translocation, the dosage needed, and time of greatest susceptibility differ enough between species that kills are not uniformly good.

The manner in which the cells are killed varies with the chemical: ammate tends to precipitate the proteins in the protoplasm, arsenic breaks down the structure of the nucleus, whereas most of the salts have a plasmolytic action. In common, these reactions disrupt normal water relations in the cells and tissues. These compounds remain soluble in the plant so they are carried through the vascular system to the various organs, thus killing the entire plant.

When used as foliage sprays, aqueous solutions are applied with machinery as in 2,4-D. Such solutions may also be applied to the cut surfaces of stems; or the crystals themselves may be poured into the frills or notches at the base of trees.

Neither ammate or sodium arsenite are volatile, so they can be used safely in respect to adjacent crops. The arsenite, however, is highly poisonous to animals and should be used with caution. Also, wood from trees poisoned with sodium arsenite should not be used as fuel, because the smoke may be poisonous. Both ammate and the arsenite are extremely corrosive to equipment and in general are more costly to apply than the hormone-type sprays. Ammate has proved effective on a greater number of brush and tree species than either 2,4-D or 2,4,5-T.

Contact herbicides which are not translocated

These include the various oils which are used as herbicides. Most oils have some harmful effects on plants. Oils will spread over the leaves in a film by reason of their low surface tension and penetrate the cuticle. They are not mobile in the vascular systems, yet they penetrate deeply into the plant by diffusion through

the lipoid phase of tissues. Oils are soluble in the lipoids of the cell walls. Saturation of the cell walls with oil prevents normal gaseous exchanges, hence the cell is smothered. Besides this lethal effect, oils have a certain amount of toxicity which depends on their content of unsaturated compounds.

Two types of toxicity are recognized: acute, which is a rapid burning of leaves; and chronic, in which the symptoms are chlorosis and are slow in appearing. Chronic toxicity alone is seldom observed among brush plants. Light compounds, such as gasoline, will burn the leaves rapidly but the injury is usually slight because most of the oil evaporates before the tissues can be saturated, unless an excessive volume is used. Acute toxicity is obtained by application of the heavier, aromatic hydrocarbons. Weed oils and diesel oil are examples. The oils most commonly used for brush control are diesel oil, stove oil, kerosene distillate, and weed oil. Diesel oil is low in cost, safe to handle, does not corrode equipment, and induces both acute and chronic toxicity.

The toxicity of oils can be increased by adding small quantities of such fortifying agents as sulphur, pentachlorophenal, or dinitrocresol which rupture the cells after being carried through the cuticle by the oil. Such solutions are used as desiccants, that is, they are used to reduce the moisture content of foliage rapidly so that it can be ignited soon after treatment. In California chaparral, a 1 percent solution of pentachlorophenol in diesel oil, applied at 50 gallons per acre (472 liters per ha.) reduced the water content of standing brush perceptibly in two hours and by 50 percent within a day.

Soil sterilants

These compounds not only kill all plants present on a treated area but prevent any other vegetation from growing for a considerable period of time. Soil sterilization is used to kill and keep out brush along power and fence lines, irrigation ditches, roadsides, and fire control lines. It is not a practical method for range improvement or forest management.

Soil sterilants are applied to the soil "broadcast" over an area or just around the base of the undesirable plants. They are carried into the soil by rain and remain there until either absorbed by plants, leached down by more rain, or broken down structurally by chemical or bacterial action. The chemicals may be absorbed by soil colloids and thus become unavailable to plants. After being taken up in solution by the plants, the cells contacted are broken down structurally.

Examples of permanent soil sterilants are: sodium arsenite, arsenic trioxide, borate compounds, and CMU [3- (parachlorophenyl) -1,1-dimethyl urea]. With several exceptions, these result in complete destruction of all plant growth. Sodium arsenite and the borates will leach out of sandy soil with excessive flooding, and certain plants are resistant to arsenic trioxide.

Examples of temporary sterilants are chloropicrin, carbon disulphide, and methyl bromide. Either 2,4-D, 2,4,5-T, or ammate can be used as a soil sterilant. Since the use of such compounds is not great in large scale brush control work, the relative advantages and disadvantages of these different compounds are not here listed.

The basic requirements of soil sterilizing chemicals are that they must remain in the root zone of the soil in an absorbable (soluble) form, and in sufficient concentration at the time the plant roots are actively absorbing (*13*).

Diluting agents and additives

Diluting agents or "carriers" make possible a uniform distribution of the highly concentrated chemicals while the additives increase their effectiveness.

Water is the most commonly used diluting agent for foliage sprays chiefly because it is cheap. Diesel oil is used as a carrier for basal sprays, but for foliage sprays it serves both as carrier and in smaller amounts as an additive to increase penetration. When used with translocated herbicides, only small proportions of oil can be used, for otherwise the leaves will burn and the movement of the chemical into the tissues will be retarded.

Additives include sticker-spreaders and emulsifiers. Sticker-spreaders are ionic or neutral wetting agents which improve adherence to the plant surfaces and reduce the surface tension of the carrier. Emulsifiers keep the oily materials in suspension in water while spraying. Aqueous solutions of ammate and amine salts of 2,4-D and 2,4,5-T usually require an emulsifier and sticker-spreader but the ester formulations generally have adequate amounts.

Methods of Application

Four basic methods are used to treat trees and shrubs with chemicals: foliage sprays, basal sprays, cut surface applications, and soil saturation. The latter has been discussed under the heading of soil sterilants.

Foliage spray

This method involves complete covering of the leaves of shrubs or trees with finely divided particles of the herbicide. The method is most commonly used in broadcast application where all plants are sprayed, desirable as well as undesirable. For this reason the selective herbicides, which, for example, may not kill grass, are especially conducive to application by sprays.

Chemicals can be sprayed in high or low volume. High volume refers to a greatly diluted form of chemical which thoroughly wets the vegetation. Quantities of 100 gallons per acre (945 liters per ha.) of chemical plus carrier are commonly used for spraying brush with ground-rig power sprayers. Low volume refers to a more highly concentrated form in which quantities applied per acre seldom are more than 10 gallons (38 liters).

Low volume application is mainly done by airplane or helicopter where cost of transporting large amounts of liquid is prohibitive.

Equipment with which spraying is done consists essentially of these items: pump, tank, agitator, boom, nozzle, and a source of power to operate the pump and move the equipment over the brush.

The simplest types of sprayers are the portable compressed-air tank sprayer and the constant-pressure knapsack sprayer. These are pumped and carried by hand. A simple air-displacement pump, mounted inside a 3 to 4 gallon (11.3 to 15 liters) cylindrical tank, will provide pressure of about 80 pounds per square inch (5.6 kg. per cm²). This forces the liquid out through the nozzle. The pressure is reduced as the liquid level goes down, and then the tank has to be pumped up again. In the knapsack type, plunger or diaphragm pumps are equipped with air chambers which keep the pressure constant no matter how much liquid is left. Hand pumping is continuous.

The number of variations in power sprayers is almost infinite but it will suffice to diagram a standard model and discuss the essential parts briefly.

Figure 53 is a diagram of a sprayer with a positive displacement pump. It is equipped with a by-pass valve or pressure regulator and a diaphragm type pressure

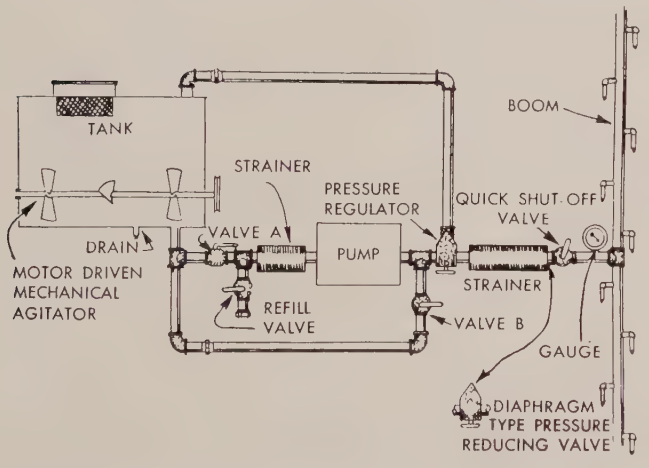


FIGURE 53. *Diagram of model boom sprayer. This model has a positive displacement pump and mechanical agitator. Principal parts are explained in text.*

After Akesson and Harvey (1)

reducing valve. The by-pass valve lowers the pressure to 100 pounds per square inch (7 kg. per cm²) or less, which is adequate for spraying brush. The tank can be back-filled by attaching a suction hose to the refill valve, closing valve " A " and opening valve " B ".

The necessary pump capacity is determined by the maximum amount of liquid to be discharged from the nozzles. The following equation can be used to calculate the value (*1*):

$$\text{Pump capacity (gal. per min.)} = \frac{\text{rate of travel (mph)} \times \text{feet per mile} \times \text{boom length in feet} \times \text{gallons per acre}}{\text{sq. ft. per acre} \times \text{minutes per hour}}$$

Thus, with a boom 25 feet long (7.6 m.), traveling at 5 miles per hour (8 km/ph.), the pump capacity must be 25 gallons (95 liters) per minute if it is desired to apply 100 gallons per acre.

$$\frac{5 \times 5{,}280 \times 25 \times 100}{43{,}560 \times 60} = 25 \text{ gal. per min.}$$

The size of the tank to be used depends on the capacity of the pump, on the volume or concentration of the liquid, and on the proximity to water or other diluting agent supply. Ground rigs can have large tanks — from 300 to 1,000 gallons (1,134 to 3,785 liters) — but the tanks on fixed wing airplanes are seldom over 150 gallons (567 liters) in capacity and for helicopters 60 to 80 gallons (227 to 302 liters). The tank can be filled by using the pump as described above. Metal tanks are easier to keep clean and are less likely to leak than wooden ones, but corrosion is a problem when ammate and arsenic compounds are used. If it is necessary to use dirty water as a diluting agent, strainers should be inserted between the tank and refill valve and also ahead of the nozzles, as shown in Figure 53.

Agitators are necessary for all mixed sprays. Stirring should be constant where soil emulsions and heavy suspensions are used, but only occasional agitation is necessary in the tank when aqueous solutions of 2,4-D, 2,4,5-T, or ammate are used. A mechanical agitator consisting of a series of paddles is mounted on a revolving shaft which runs through the bottom of the sprayer tank. It can be geared to the pump engine. Hydraulic agitation can be installed by recirculating the excess flow of liquid from the pump through a boom-like pipe laid near the bottom of the tank. This works best with a centrifugal pump (Figure 54).

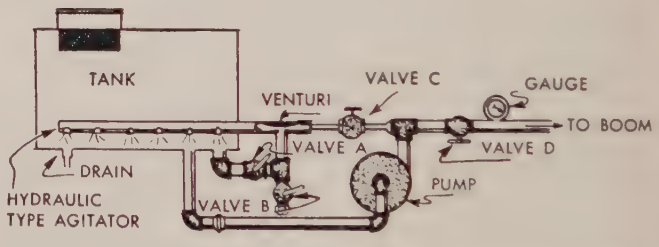


FIGURE 54. *Diagram of sprayer with centrifugal pump and hydraulic agitator. No by-pass valves are needed with centrifugal pumps. In sketch, valve " D " is a pressure reducing valve, or, if pump pressure is uniform, it is a simple gate valve. Valve " B " attaches to a suction hose for backfilling when " C " is open and " A " is closed. A venturi operates the agitator boom.*

After Akesson and Harvey (1)

Booms are made of pipes ranging from ³/₄ inch to 2 inches (1.9-5 cm.) in diameter. Smaller pipe is unsatisfactory because the resistance to liquid flow lowers pressure at the nozzles during large volume spraying. The larger pipe is stronger and less apt to whip around when projected out over the brush. Also, it is easier to cut holes in larger pipe to insert nozzles. The length of the boom is governed by the size of the tank and the

pump. The length needed to cover an area in a given amount of time can be calculated as follows:

$$\text{Length of boom} = \frac{\text{sq. ft. per acre} \times \text{no. of acres}}{\text{time of actual spraying} \times \text{rate} \times \text{ft. per mile}}$$

To compute the necessary boom length to cover 500 acres (202 ha.) in 10 eight-hour days with a rig which will average 4 miles per hour (6.4 km/ph.), the values are substituted as follows:

$$\frac{43{,}560 \times 500}{80 \times 4 \times 5{,}280} = 12.9 \text{ feet}$$

Two types of nozzles are used: those giving a flat, fan-shaped spray and those giving a hollow, cone-shaped spray. The flat spray gives the more uniform coverage and a more forceful application. A minimum of 10 to 25 pounds per square inch (0.7-1.8 kg. per cm²) of pressure is needed to make the liquid fan out from the nozzle. A wider fan and finer droplets results with increasing the nozzle pressure. Nozzles which produce the conical spray do not plug as easily and are less likely to fog at low rates of discharge. The width of the fan, spacing of the nozzles, and height of

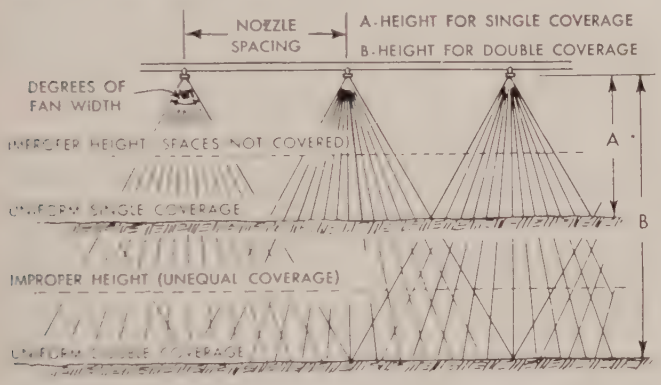


FIGURE 55. *Dependency of coverage on nozzle spacing, fan width and height above ground.*
After Akesson and Harvey (1)

the boom determine the uniformity of coverage (Figure 55). Discharge in gallons per acre can be computed from the following equation:

$$\text{Gallons per acre} = \frac{5{,}940 \times \text{gallons per minute}}{\text{nozzle spacing in inches} \times \text{miles per hour}}$$

The value 5,940 is a constant derived from the equation:

$$\frac{\text{Minutes per hour} \times \text{ft. per mile}}{\text{sq. ft. per acre} \times \text{in. per ft.}} = \frac{60 \times 5{,}280}{43{,}560 \times 12} = 5{,}940$$

For aircraft, the effective swath width is greater than the length of the boom. If the discharge rate of the nozzles is known, gallons per acre can be computed from this equation:

$$\text{Gallons per acre} = \frac{1{,}000 \times \text{gallons per minute}}{2 \times \text{effective swath width} \times \text{mph}}$$

The power needed to run the pump can be calculated when the discharge in gallons per minute is decided upon and the efficiency of the pump is known. The following equation is helpful in finding the approximate power needed to drive a pump:

$$\text{Horsepower} = \frac{\text{lbs. pressure} \times \text{discharge in gallons per minute}}{1{,}730 \times \text{efficiency in \%}}$$

Pumps vary from 20 to 80 percent efficiency; if a low value is used, the calculations will lead to an engine that will have ample power.

The engines can be separate from the one that drives the rig or the same in which case the belt pulley or power take-off is connected to the pump. Pumps for aircraft sprayers can be powered by the hydraulic motors which operate the flaps or landing gear, wind-driven propellers, accessory drive pads from the plane's engine, or by separate electric motors.

The various types of mountings that can be made either on ground rigs or aircraft are too numerous to discuss here, but some are shown in Figures 56, 57, 58, 59, and 60.

Aircraft spraying of brush foliage has certain advantages over ground spraying. Large acreages can be covered cheaply and rapidly. A considerable portion of the cost of air spraying involves locating a landing strip near the area and getting the plane to it. This cost is the same whether the acreage is large or small, and consequently, the cost per acre for aircraft spraying is high when few acres are being treated. On small areas, ground application is generally cheaper. Aircraft can be used when the ground is wet or covered with snow. It is possible to cover fully, but not necessarily uniformly, the vegetation growing on rugged terrain. Chemicals can be applied in low volume, and for many species this is a decided advantage.

Spraying from helicopter can be done much closer to the ground than by fixed-wing aircraft. On rough terrain, the helicopter is able to follow crooked contour lines, so that constant distance above the ground surface will give more uniform spray distribution. Scattered brush patches or clumps of undesirable trees can be pin-pointed at slow speed from low altitudes, obviating the spread of chemicals over the non-susceptible vegetation between. The downwash from the craft's rotor results in a turbulent action which is especially advantageous in foliage of medium or high density. The spray is forced downward violently; then there is a sharp uplift. This action coats both under and upper sides of leaves, and distributes the chemical throughout the depth of the foliar stratum. Another advantage of the helicopter is the small space needed for take-off and landing; seldom is it impossible to locate a suitable helicopter port somewhere within or adjacent to the brush field being sprayed. However, its pay load is smaller than that of airplanes, thus increasing the cost of operations. The helicopter is not effective in mountains higher than 6,000 feet (1,830 m.) above sea level.

FIGURE 56. *Bean sprayer mounted on a trailer. The sprayer pictured here has a tank of 150 gallons (568 liters) capacity. The power unit is an air-cooled, one-cylinder Briggs and Stratton gasoline engine. It is rated at 5 1/4 h.p. with 3600 r.p.m. maximum. The pump has a rated capacity of 7 gallons (26.5 liters) per minute at 400 pounds per square inch (28 kg. per cm²) pressure. This outfit is used for fire fighting, controlled burning, and spraying cattle as well as spraying brush control. It is made by the Food Machinery Co., John Bean Division, San Jose, California.*

California Division of Forestry

FIGURE 57. *Pump and long boom mounted on wheel tractor. This type of equipment works well only on fairly level ground and in low vegetation such as in sagebrush, as shown, or in young sprouts of taller growing species.*

U.S. Forest Service

FIGURE 58. *Axial-flow turbine mist blower mounted on a truck. The turbine blows out a large volume of air at about 150 miles (240 km.) per hour, carrying with it a relatively small quantity of liquid which is injected into the air stream through atomizers. High humidity reduces evaporation loss so that early morning or late afternoon spraying is most efficient for this machine. A slight breeze is advantageous either for increasing the range (with wind) or increasing the turbulence (against wind). Swaths of 60 to 100 feet (18.3-30.5 m.) can be covered under optimum conditions (25).*

U.S. Forest Service

The chief disadvantage in using aircraft to spray brushland is the probability of drift due to air currents at flight altitude. Besides damage to neighboring crops, it results in poor aerial distribution of liquid on the foliage.

Aircraft spraying is hazardous to pilots. Much of the land covered by brush today is characterized by steep slopes and canyons. These are extremely dangerous to fly at altitudes which provide most effective dispersal of chemicals.

Ground rigs are most useful where high volume sprays can be employed, where the soil surface is level and firm enough for wheeled machinery, and where the brush is not too dense to impede travel of the implement. Hand sprayers are useful on smaller tracts, on terrain too rough for wheeled machinery, and in forests where only a small proportion of the plants is to be eradicated.

FIGURE 59. *Spraying mesquite with fixed-wing plane. Boom, mounted below lower wing of bi-plane, is equipped with 14 nozzles.*

Texas A. and M. College

FIGURE 60. *Spraying big sagebrush with helicopter. This craft can fly safely within a few feet of the brush tops.*

U.S. Forest Service

FIGURE 61. *Killing mesquite with kerosene. Long spouts on cans aid in getting the oil to the base of the stem. The oil seeps down to the bud zone of the plant.*
Soil Conservation Service

FIGURE 62. *Filling notches with ammate crystals. Cups are cut as close to the ground as possible for more rapid killing action and less sprouting. Notches should be 6 inches (15.2 cm.) apart from edge to edge. Two are enough for trees up to 6 inches d.b.h., but an extra notch should be cut for each 2-inch (5.08 cm.) increase in stem diameter. A 3-man crew is efficient: two to make notches, and one to apply the chemical. If a dye is added to the chemical, it is easy to tell which notched trees have been treated.*
U.S. Forest Service

Basal spray

This method involves the application of chemicals in a concentrated form on the lower portions of the stems of woody plants. The herbicide can be poured out of a can or painted on with a brush. When done in this way, waste is not excessive and the chemical can be used at full strength. When a sprayer is used, nozzles giving a fan-shaped spray are best. There is apt to be waste so some dilution is recommended. However, it is desirable to apply enough liquid so there is runoff down the stem into the soil.

Any of the translocated oil-soluble herbicides can be used for basal spraying. They are especially effective when light diesel oil or kerosene is used as carrier to penetrate through the bark to the phloem. Small trees, 3 inches (7.6 cm.) or less in diameter, are readily killed by this method because of their thinner bark. Oils alone are also useful for basal treatment. They are most successful in sprouting species. The oil is allowed to run down the stem to the bud zone. Both the crown and the immediately adjacent soil is saturated; the oil penetrates and kills the meristematic tissues in the buds, thus preventing sprouting (Figure 61).

Cut-surface applications

The application of chemicals on the cut-surfaces of stems kills top growth and prevents sprouting in the notching and frilling methods and prevents crown or stump sprouting in the stump treatments. The techniques involved are relatively simple. Ammate, sodium arsenite, and amine or ester forms of 2,4-D and 2,4,5-T are most frequently utilized in the cut-surface methods.

Notch method (Figure 62). Notches or cups are cut through the bark of shrubs or trees at intervals around the base. A satisfactory notch can be made with two strokes of an axe, the lowermost cut being downward and extending into the sapwood or at least to the cambium so that the phloem vessels are exposed on the upper surface. Since there are no suberized layers to be penetrated, oil solutions are not necessary. Water soluble chemicals of the translocated type, either in solution or as crystals, can be poured into the cup with a can or spoon. The pump-type engineer's oilcan with a long spout works well or some other can-and-spout device can be improvised for this purpose. The number of notches needed depends on the species and diameter of the stem, as does the concentration and absolute quantity of chemical per notch.

Frill method (Figure 63). A frill is essentially a series of contiguous notches around the base of a stem. Frilling need not result in a clean, wide cut through the cambium as does girdling but should provide a convenient receptacle around the circumference of the stem in which to place the chemical. There is little if any lateral movement of water solutions, consequently the notch method kills certain segments of the plant aligned vertically with the notches, whereas those aligned with the interspaces may sprout. This effect is minimized with frills. The frill method is best for larger trees, those 12 inches or more in diameter at the base. Naturally frilling a tree takes more time than to notch it, and more chemical is used, but these disadvantages are compensated by the higher percentage of kill.

Cornell tool (Figure 64). This tool consists of a 5-foot (1.5 m.) length of pipe in two sections. The upper part is 4 feet (1.2 m.) long and is the reservoir for the chemical; the lower foot is fashioned into a cutting spud with a concave edge. Inserted between the two sections is a brass cylinder with a ½-inch (125 mm.) bore which serves as a valve-block and dosage meter.

FIGURE 63. *Pouring ammate solution into a frill. Frilling at this height is convenient but allows more sprouting on most trees than do low-cut notches. The method should be confined to larger trees. An efficient operation consists of a 4-man crew, three making frills and one applying the chemical.*

U.S. Forest Service

FIGURE 65. *Pouring ammate crystals on V-cut stump to prevent sprouting.*

U.S. Forest Service

Two valves, attached to an $^1/_8$-inch (32 mm.) wire stem that passes through the cylinder and then up through the reservoir, are so spaced that when the upper valve is seated, the lower valve is open, and vice versa. In operation, a downward thrust of the cutting tool is followed by a quick pull and push of the stem rod which

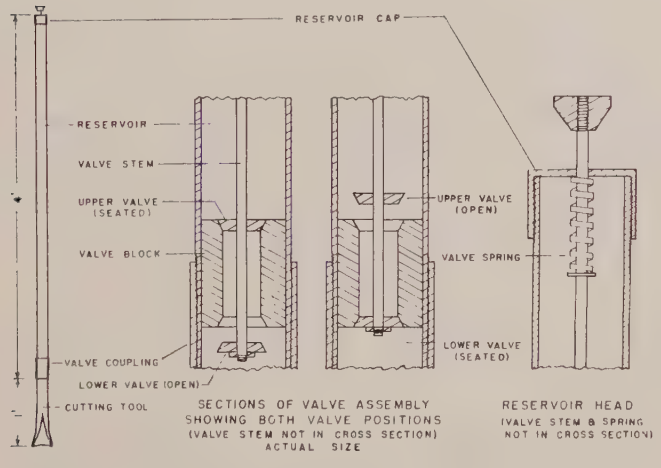


FIGURE 64. *Diagram of the Cornell tool.*

After Cope and Spaeth (*9*)

allows a measured amount of liquid to flow into the cut made in the tree. This model was designed at Cornell University (*9*). Other "tree injectors" are based on the same principle but have the trip valve operated automatically by the impact of the tool into the tree.

Stump treatments. Stumps of sprouting species can be treated in any one of three ways: by basal spray, by pouring the poison into a notch or frill around the base, or by applying the poison to the top or cut surface. The chemical can be applied with a spoon (Figure 65) or with a paint brush. The solution should be daubed on until it nearly runs off. If the stumps are cut low and square, most of the liquid will take effect. Small stems can be cut to give the stump a V-shaped surface. The groove can be filled with crystals or painted with solution.

Combination Methods of Brush Control

Chemicals are most effectively used along with some other method of brush control, such as mechanical treatment, fire, or grazing management. The reason for this is that brush species in mixed stands are not equally susceptible to chemicals and that the dead stems remain standing for some time. Following successful kills by chemicals, railing, cabling, or bulldozing can be used to break up the stems. Fire is frequently used either before or after spraying. Sprouts and brush seedlings are usually more susceptible to hormone chemicals than mature plants of the same species; thus controlled burning followed by foliage spraying is an effective brush control measure. For burning in the spring when the moisture content of the plants is high, the use of quick-acting contact sprays as desiccants, is a worthwhile preparatory measure.

The possibility of using selective foliage sprays in conjunction with intensive browsing has not been fully explored. Hormone-type herbicides which react better when a larger leaf surface is exposed will, therefore, kill those plants in a mixed stand of brush that are least browsed, that is, those least preferred by stock. This selective action favors the desirable browse plants.

Biological vegetal control

Brush clearing by so-called "biological" means is essentially concerned with destruction of the sprouts and seedlings of woody plants after the cover has been burned or worked-over mechanically. Goats, and to a lesser extent deer, are the most effective animals for killing thinned stands, such as interior live oak of California and certain other brush plants (*32*).

When palatable sprouts begin to appear, after the clearing operation, enough goats should be placed on the area to keep the shoots and seedlings browsed down (Figure 66). The animals are restricted to relatively small areas by fencing. Areas having abundant sprouts may require three goats to the acre, and others only two goats during the entire grazing season. As the vegetation gradually changes from brush to grass the acreage per animal is increased to maintain the goats in fairly good condition. The area must be stocked to the full capacity of the browse, usually for three to five years; otherwise only a portion of the sprouts will be destroyed. As a rule goats will show at least a small profit when handled as described. Similar results can be obtained in many instances with sheep and cattle (Figure 67).

On small burned areas — 4 to 5 acres in size — deer will destroy sprouts and seedlings of chamise, oaks, and other palatable woody plants (Figure 68). Larger burns fail to result in clearing because the browsing is not concentrated enough.

Another effective means of controlling brush seedlings is by planting burned areas with aggressive forage plants. Studies have shown that in dense grass brush seedlings failed to extend their roots into zones of avail-

FIGURE 66. *Result of goat browsing. Formerly, the area was a dense stand of chamise. It was burned in 1925 and fenced as seen. The foreground was pastured with goats while the portion across the fence grew back to brush. Annual grasses and forbs now constitute the cover in the goat pasture.*

University of California

FIGURE 67. *Effect of cattle browsing on coyote brush. Area on left of fence has been moderately grazed by cattle for the past 20 years; area on right ungrazed for the same length of time. Cattle do enough browsing of tender seedlings to prevent aggregation of plants.*

University of California

FIGURE 68. *Effect of deer browsing on chamise. An attempt at intensive range management for deer through controlled burning has killed out all the browse. The managed area was small and invited many more deer than the area could support.*

University of California

FIGURE 69. *Brush control with grass competition. The area shown had formerly been dense brush. It was controlled burned and portions seeded to annual ryegrass. The left hand side shows a stand of mature ryegrass with no brush seedlings; the unseeded right hand side, a dense population of one-year-old wedgeleaf ceanothus and yerba santa seedlings.*

After Schultz, Launchbaugh, and Biswell (36)

able late summer water (*36*). In contrast, brush seedlings growing where there was no competing vegetation sent abundant roots into the zone of late summer water (Figure 69). In addition, the grass cover stabilizes the soil, supplies forage, and provides fuel if additional clearing by fire is desired.

Biological control of vegetation by diseases and insects is a natural phenomenon that often thins native stands of various noxious plants, including brush species. These depredations, however, seldom result in lasting control. On the other hand, biological control offers great possibilities with introduced noxious plants because their natural predators may be introduced unaccompanied by their own natural diseases or parasites. In Australia, remarkable success was achieved in controlling introduced species of cacti, and more recently in California and Oregon with St.-Johns-wort by beetles that fed exclusively on these plants.

FORTHCOMING MEETINGS, 1957

21 January to 5 February	Geneva	International Consultation on Insulation Board, Hardboard and Particle Board
March	Indonesia	Asia-Pacific Forestry Commission (4th Session) and Teak Subcommission (2nd Session)
22 April to 1 May	Paris	International Poplar Commission (9th Session) and Poplar Congress
7 to 14 May	Rome	European Forestry Commission (9th Session)
3 to 19 June	Moscow	FAO/ECE Joint Committee on Forest Working Techniques and Training of Forest Workers (2nd Session)
9 to 20 July	Guatemala	Latin-American Forestry Commission (6th Session)
28 September to 10 October	Iraq	Near East Forestry Commission (2nd Session)
November	Rome	FAO Conference (9th Session)

Scientific Nomenclature of Forest Trees

by Elbert L. Little, Jr.
United States Forest Service

The replacement of well-established scientific names of important forest trees and other economic plants through revival of old overlooked names is a serious, annoying problem for foresters and other workers in applied plant sciences. Fortunately, solutions are now being actively considered and should be adopted by the Ninth International Botanical Congress at Montreal in 1959.

Examples of scientific names of forest trees that have been replaced by old names through bibliographic searches of plant taxonomists are too familiar to require mention. Of particular concern to foresters is the recent change of the most important timber tree, Douglas-fir, from *Pseudotsuga taxifolia* (Poir.) Britton to *Pseudotsuga menziesii* (Mirb.) Franco. A possible benefit is the increased interest aroused among foresters in plant nomenclature and their support of proposals to amend the International Code of Botanical Nomenclature toward more stabilization. Thus, the Society of American Foresters, with membership of about 10,000 professional foresters, has requested through its Council retention of the name *Pseudotsuga taxifolia* and four other specific names and has endorsed the principle of the proposal stated below as well as other means toward stabilization of important tree nomenclature.

Soon after beginning the study of tree nomenclature more than fifteen years ago the writer saw the need for a rule of this kind. For the Seventh International Botanical Congress at Stockholm in 1950, an amendment was submitted similar to that quoted below to reject a name as not effectively published if it neither had been accepted by a second author nor listed in an index of scientific names within one hundred years after publication. Unfortunately, an earlier version was substituted in the published proposals and the improved revision was not formally considered. At the same time, the writer offered a proposal to conserve specific epithets of plants and stated the arguments for *nomina specifica conservanda* (*Phytologia* 3 : 90-100. 1949.). There was no endorsement of these proposals by forestry organizations at the Stockholm Congress; instead, one botanist read statements from representatives of forestry schools in the United States indicating that no unanimity on the subject existed among American foresters.

This problem of nomenclature stabilization was one of the most important considered by the Nomenclature Section of the Eighth International Botanical Congress at Paris in 1954, in amending the International Code of Botanical Nomenclature of 1952. Two proposals toward this object gained preliminary approval but were defeated by small margins in the final voting.

At Paris, the proposal for a Special Committee on Stabilization was carried unanimously, and its members were elected. Also carried by a considerable majority was a resolution "that something should be done" to solve the present problems of nomenclatural instability, expressing the conviction that a change may be accepted but that up to now the right proposal had not yet been presented.

Dr. J. S. L. Gilmour, Director, University Botanic Gardens, Cambridge, England, chairman of the Special Committee on Stabilization, listed five possible lines of approach discussed at Paris, from one or more of which acceptable proposals would seem likely to be evolved:

(a) *nomina specifica conservanda*;
(b) *nomina specifica rejicienda*;
(c) banning of certain books;
(d) banning of names not taken up after a certain date;
(e) the recognition in the rules of "economic names" in addition to the strictly correct "botanical names".

He also asked members of this committee to send him not later than May 1, 1955, a list of widely used names which on a strict application of the rules should be replaced by less well-known names, in order to assess the approximate number of actual cases likely to be involved.

Foresters have the opportunity to participate in developing a workable solution and can submit lists of scientific names desired for retention in place of obscure recently revived names. Forestry organizations, institutions, and societies can endorse these proposals publicly and send copies of their resolutions to this committee and to the president of the Ninth International Botanical Congress, Dr. Jacques Rousseau, Director, Montreal Botanical Garden, 4101 Sherbrooke St. E., Montreal, Quebec, Canada. Also, they can request authorization to send voting delegates to this congress at Montreal in 1959. Support for the following proposal will be appreciated.

The writer proposes the following new article as an amendment to the International Code of Botanical Nomenclature under Section 5, Conditions and Dates of Effective Publication (after Article 41 in the 1952 edition):

"A name of a taxon is not effectively published if it neither has been accepted by a second author nor has

been cited in an index of scientific names within fifty years after publication or by 1 January 1960, if published before 1910."

This proposal provides for the automatic rejection of obscure old names more than fifty years old, as though they never had been published. Stressing effective publication rather than rejection of individual names, it is related also to Section 13, Rejection of Names and Epithets. Just as microfilm is not accepted (Article 39), names in obscure or rare works not afterwards adopted or indexed likewise do not meet the conditions of effective publication.

Under this proposal an obscure old scientific name of a species, genus, variety, or other group could not be revived to upset usage unless it either has been accepted by a second author or listed in an index of scientific names before 1960. All names heretofore adopted by a second author and future names so recognized within fifty years after first published would not be affected. Likewise, this proposal would not apply to all names already cited in *Index Kewensis and Supplementa* as well as all names in *Gray Herbarium Card-index* and any other indexes of nomenclature. The date 1910 is added to prevent the rule from becoming retroactive. Names published between 1753 and 1910 have had from fifty to more than two hundred years for adoption. Every name published after 1910 would be granted fifty years' time in which to be indexed or accepted by a second author before it could be rejected. Ambiguities of a proposal considered in 1954 about "currently accepted" names and those "not taken up in a botanical paper published since 1900" are avoided.

The time interval of fifty years is believed to be the most satisfactory but could be changed if desired. As a precedent, names of genera, families, and orders to be conserved are preferably such as have come into general use in the fifty years following their publication (Article 24). A few foresters have suggested a shorter period. However, a reasonable number of years is required for cataloguing and publishing indexes and for contemporary workers to become familiar with new names, evaluate them, and check the nomenclature and synonymy. Also, a name in print only a few years has not become widely established in usage and could be changed without much confusion.

A desirable feature is placing the responsibility for the rejection of an obscure name upon its author for not publishing it effectively in a medium available to contemporary botanists. For practical purposes, an old name that has escaped all indexes and remained unrecognized by anybody has not been published. Certainly any scientific name now more than fifty years old which cannot meet one of the two modest qualifications of either acceptance by a second author or discovery by a bibliographer for an index was not effectively published in the first place! Whether or not the work was rare or primarily for others, obviously something was wrong with the distribution or circulation of the original printed matter in its failure to reach the general botanical public (Article 39 and Recommendation 39A). Even where deliberately ignored by contemporary authors because of prejudice or other reasons, names in printed matter distributed to the general botanical public should have been picked up by later indexers before now.

Under this proposal an obscure old name has no status in nomenclature but is simply ignored somewhat as a *nomen nudum*. It is unnecessary to deliberate upon whether to restore the newly discovered old name or even to establish its synonymy or type, though it could be cited as an ineffectively published synonym if desired. No list of these rejected names is needed. A taxonomist discovering a specific name more than fifty years old omitted from *Index Kewensis and Supplementa* is not required to make any further search of botanical literature to determine whether the name was used again or indexed elsewhere.

The burden of proof is upon anyone wanting to revive an obscure old name. He could not resurrect the name to upset existing nomenclature unless by searching through botanical literature he could find the name listed in an index or accepted by a second author. If an author should revive an old name in violation, then this later publication would be the date of effective publication.

It has been argued that second use of the name might eventually be found (for example, Rickett, H. W., and Camp, W. H., *Taxon 4*: 37-40. 1955). However, any name now accepted, except the conserved generic and family names, is subject to the risk of reduction to synonymy at any time through discovery of an old name in a rare work. This proposal would reduce the probability very significantly to the low frequency of two rare events instead of one, the original publication and a second acceptance or listing.

One question raised is that some names of taxonomic groups of small size or restricted geographic distribution might pass a half century known but dormant because later botanists might have no occasion to refer to them. However, these names would be protected merely by listing in *Index Kewensis and Supplementa*. The numerous unused names published by Constantine S. Rafinesque in rare works ignored by contemporaries would be exempted through listing in E. D. Merrill's *Index Rafinesquianus* (1949).

This proposal should not be confused with those to conserve or reject specific names and should be acceptable even to taxonomists who strongly oppose the latter. Conservation or rejection of specific names could become of somewhat broader application and would require in each case special action individually by an International Botanical Congress.

Only a very limited number of names of any category could be affected by this proposal. It would eliminate the need for conservation of generic names upset by future discovery of earlier synonyms. Some old unused varietal names might be rejected automatically, especially since varieties are omitted from *Index Kewensis*. However, dropping of those old untypified varietal

names may help clarify future nomenclature. New World varieties back to 1753 are being listed in *Gray Herbarium Card-index*.

Not retroactive, the proposal could not apply to any old names already taken up by a second author. To attempt to change automatically some names already in various degrees of acceptance would create more confusion. These cases could best be considered individually under a separate article for conserved or rejected names.

INTERNATIONAL UNION OF FOREST RESEARCH ORGANIZATIONS
TWELFTH CONGRESS, OXFORD 1956

The above paper was submitted to the Twelfth Congress of the International Union of Forest Research Organization which was held at Oxford from 7-14 July, followed by eight simultaneous tours to various parts of England, Scotland and Wales to see at first-hand the remarkable and very interesting progress made by the Forestry Commission in Great Britain over the last 10 years.

The Congress drew a large attendance, there being 240 participants from some 40 countries, the membership of IUFRO having expanded greatly in recent years. Specially noteworthy was the presence at Oxford of representatives of the Regional Experiment Stations of the U.S. Forest Service, and of the Forestry Institute of the Academy of Sciences in Moscow.

Lord Radnor, Chairman of the United Kingdom Forestry Commission, and Mr. Leloup, Director of FAO's Forestry Division, attended when the Minister of Agriculture, Fisheries and Food of the United Kingdom opened the Congress.

The Minister said that despite the immense changes in the world since the Union was formed in 1890, it had gone from strength to strength, playing an increasingly important part in helping to widen the world's knowledge of forestry. Science had advanced in every field at an astonishing rate and today the sheer mass of information that confronts the research worker in forestry, as in every other branch of science, presented him with a most formidable problem. The importance of such international gatherings, from the purely scientific point of view, was very great. But he believed that not one bit less was their value in creating close and intimate relations between important representatives of many different nations, all united in a common interest — for this could only help to strengthen the cause of world peace and understanding.

"We in the United Kingdom are now engaged in trying to build up a new forest estate partly on the ruins of an old one and partly on completely new ground. Our aim is to establish eventually a productive forest area of five million acres

two million from existing woods when they are restored and three million from bare land to be afforested. This national aim is a combined operation, shared between the owners of our private woodlands and the Forestry Commission, with its direct responsibility for our new national forests".

The technical discussions at the Congress, grouped under ten section headings, were spread over three days. Over 150 background scientific papers had been submitted, and the conclusions and recommendations of the section meetings were endorsed at the final plenary session of the Congress. More details of the results of the Congress will be given in the next issue of *Unasylva*.

The International Council of IUFRO, which is the highest authority for all matters of organization and management, elected Mr. J. Macdonald (United Kingdom) as President of the Union in place of the retiring President, Professor Pavari of Italy. A number of changes in the Statutes of the Union were proposed and approved, and the membership of the IUFRO Permanent Committee was extended to 11, members from Latin America, Sweden, Japan, Belgian Congo, Austria and Yugoslavia being elected to vacancies. Professors Wilm (U.S.A.), Biraghi (Italy) and Firat (Turkey) were elected to vacancies among Section Leaders.

It was decided that the next Congress of IUFRO should be held in Vienna at a date to be determined later by the new President.

Queen Elizabeth recently unveiled a commemorative plaque to mark the planting of the millionth acre of new forest by the Forestry Commission in the United Kingdom. On the right is Lord Radnor, Chairman of the Forestry Commission.

Commodity Report

Sawn Softwood

Production and Trade

The world market in sawn softwood, which in 1953 had regained its stability after the short-term fluctuations in the previous years, could in 1954 and 1955 be characterized by a relative firmness and by a steadily growing demand. The marked progress in world industrial activity and economic expansion, so manifest in the past years, continued throughout the year 1955 and the first half of 1956; in the latter period, however, a certain tendency of slowing down of the rate of growth became increasingly apparent in a number of countries.

TABLE 1. – PRODUCTION OF SAWN SOFTWOOD
(in thousand standards)

Region	1950	1951	1952	1953	1954	1955
Europe	*9 590*	*9 660*	*8 730*	*9 100*	*9 520*	*9 980*
of which:						
Finland	875	1 055	750	904	1 030	1 070
Sweden	1 265	1 450	1 275	1 490	1 600	1 700
Norway	358	310	400	360	384	365
Austria	697	694	629	684	804	827
Western Germany	1 709	1 598	1 380	1 275	1 263	1 399
France	655	792	578	556	687	749
Eastern Europe	2 680*	2 520*	2 450*	2 615*	2 561*	2 689*
U.S.S.R.	*9 000**	*10 000**	*11 000**	*12 080**	*12 550**	*13 000**
U.S.A.	*15 920*	*15 050*	*15 270*	*14 930*	*14 790*	*15 950*
Canada	*3 436*	*3 657*	*3 503*	*3 636*	*3 639*	*3 972*
Latin Amer.	*1 000**	*1 200**	*1 106**	*1 120**	*1 180**	*1 250**
of which:						
Brazil	560	746	760	717	748	794
Africa	*190**	*200**	*200**	*210**	*220**	*230**
Asia	*2 920**	*3 030**	*3 230**	*3 220**	*3 220**	*3 300**
of which:						
Japan	2 457	2 544	2 792	2 771	2 660	2 700
Oceania	*360*	*390*	*400*	*390*	*420*	*440*
WORLD TOTAL	*42 420*	*43 190*	*43 490*	*44 690*	*45 540*	*48 120*
Index (1950 = 100)	100	102	103	105	107	113
Index of world industrial production (1950 = 100)	100	108	111	119	119	131

* Estimated figures.

The production and trade of sawn softwood both profited from the generally favorable economic conditions and developments in most parts of the world in 1955 and reached, in fact, new record levels. World production of sawn softwood in 1955 showed a rise of 5.75 percent from the level of a year earlier; this increase compares rather favorably with the 10 percent increase in total world industrial production from 1954 to 1955 (Table 1). World exports of sawn softwood, on the other hand, showed a rise of 11.3 percent from the level reached in 1954, as against an increase of 7 ½ percent in the total volume of world export trade (Table 2). The relatively greater growth of the volume of world trade in sawn softwood was chiefly due to stock-piling in a number of importing countries in the course of 1955.

TABLE 2. – WORLD EXPORTS OF SAWN SOFTWOOD
(in thousand standards)

Region	1950	1951	1952	1953	1954	1955
Europe	2 460	2 740	2 130	2 700	2 900	3 090
U.S.S.R.	180	140	130	240	310	390
North America	2 050	2 220	2 000	1 980	2 380	2 700
Latin America	290	310	220	280	250	330
Africa	7	10	5	7	2	3
Asia	2	100	20	20	20	20
Oceania	7	10	10	10	20	20
WORLD TOTAL	5 000	5 530	4 520	5 240	5 880	6 550
Volume index of world trade in sawn softwood (1950 = 100)	100	111	90	105	118	131
Volume index of total world trade (1950 = 100)	100	112	111	118	124	133

One of the salient features of the development of world trade in 1955 was the increase that took place in trade within the most important regions, North America and Europe. The trade between regions, on the other hand, did not show any significant growth from the level in 1954. Exports by European countries to overseas even declined markedly and had to be compensated by increased imports from North America and Brazil, notably with regard to imports by Australia and South

Africa. North America alone accounted for more than one half of the total increase of world production of sawn softwood, largely because of the heavier demand brought about by the record level of construction in the U.S.A. in 1955. The same factors made the increase in the volume of exports of sawn softwood from Canada to the U.S.A. in 1955 to account for nearly one half of that in the total world trade. In Europe, the developments on the sawn softwood market in 1955 were primarily marked by the British importers' purchasing for this year; this had in the course of 1955 led to heavy stock accumulation in the United Kingdom and in some other importing countries in Europe, which, following the British example, had purchased for delivery in 1955 more than was apparently justified by current requirements.

At the beginning of 1956, while the North American market continued firm and the Canadian exporters were meeting an unusually heavy demand from the U.S.A., the European market was characterized by an almost complete standstill. Importers in most of the principal importing countries had, in the course of 1955, to face increasing financial commitments as a result of the generally rising landed cost of timber, greater stockholdings and various credit-restricting measures adopted in 1955 by most governments in western Europe. Consequently, it had already been clear well before the end of 1955 that import requirements for the year 1956 were generally going to be lower than a year earlier. In fact, sawmills in the principal exporting countries in Europe were early in reducing their production of sawn softwood for 1956. Consequently, the slow progress made in Europe by the end of 1955 in the sales and purchases for delivery in 1956 was no surprise to anybody in the trade. The early months of 1956, however, brought about a further unexpected delay in the purchasing for this year. The exceptionally cold weather reduced temporarily the consumer demand, particularly in building, and both importers and wholesale merchants found it difficult to reduce their stocks as they are accustomed to do before the shipping season starts. This, together with the increasing financial burden caused by the slow turnover, led the import trade to hope that, by prolonging their cautious attitude and activity in purchasing for the current year remaining slack, exporters might be induced to make at least some price concessions. The result of this policy was a "tug-of-war" between the exporters and the importers as to who could hold out longest.

In the exporting countries, especially in northern Europe, the protracted lull on the market began to cause serious financial difficulties to the smaller sawmills which seemed even willing to accept downward price adjustments if only to accelerate sales. The larger sawmills, on the other hand, generally persevered in their firm attitude, refusing to accept any major changes until the month of May, as a result of the readjusted Soviet export quotations for western Europe.

When the market in April was generally thought to be mature for a revival of sales and purchasing activity, the British Government announced the liberalization of the bulk of its strategic stocks of sawn softwood, some 150,000 standards. The purpose of this decision was very clear: the country, struggling with foreign trade difficulties, had to find ways and means to reduce the import expenditure for 1956. By releasing the strategic stocks for current consumption, the volume of imports otherwise required to meet the 1956 demand, would be reduced correspondingly. It was normal therefore that the British import trade which had been getting ready to proceed in its purchasing for 1956 wanted first to learn the categories and dimensions of sawnwood contained in this unexpected offer before placing any substantial further contracts abroad.

As most other importing countries had, throughout the spring of 1956, been waiting for the British initiative to break the prolonged lull, the long-expected revival of activity was not forthcoming. Only gradually and in relatively small parcels were contracts placed in the principal exporting countries by western European importers in the last months of the spring, and the activity did not show any marked change in the course of the summer of 1956. Under these conditions it appeared rather likely that purchasing in Europe for delivery in this year would continue unusually late into the year, perhaps even close to the end of the main shipping season. Of all the principal importing countries, the United Kingdom seemed at the beginning of August to have secured the largest part, if not the totality, of its import requirements for 1956, while other countries still had considerable further purchasing to accomplish in order to meet their total requirements for the year. Of the exporting countries, on the other hand, the Soviet Union seemed to have sold the greater part of its estimated export availabilities to western Europe for 1956 — not quite 300,000 standards — while the northern European countries and Austria still had considerable quantities available, wherewith to meet demand during the rest of the year. By and large, however, the European supply/demand situation appeared balanced for the year as a whole. The absence of important Canadian sales to western Europe, caused by high ocean freight rates and by the strong demand for Canadian sawnwood from the U.S.A., made the prospects of further selling somewhat brighter to those European exporters who still had quantities to dispose of.

Consumption and stocks

The world consumption of sawn softwood in 1955 appears to have been some 5 percent higher than in the previous year. The increase of consumption in the U.S.A. caused chiefly by the building boom in 1955 alone accounted for about 60 percent of the increase of total world consumption. In Europe, the actual consumption was likely to have increased rather insignificantly, while additional demand had been brought on the market by the above-mentioned stockpiling in the principal importing countries. In other parts of the world, the consumption showed, in general, a rising

trend, though, with the exception of the U.S.S.R., the actual increase remained relatively unimportant.

The development of the U.S. market of sawn softwood is illustrated by the figures on stocks and unfilled orders at the end of each quarter and by the new orders received during the quarters (Table 3). The Table

Table 3. – Development of Soft Sawnwood Stocks, Unfilled and New Orders of Sawn Softwood in the U.S.A.
(in million board feet)

	Date					
Stocks at mills:	31.12.54	31.3.55	30.6.55	30.9.55	31.12.55	31.3.56
Total sawn softwood	5 275	5 259	5 004	5 062	5 429	5 380
Douglas fir	879	1 016	837	873	1 032	1 020
Southern pine	1 746	1 781	1 743	1 658	1 731	1 806
Western pine	1 764	1 601	1 586	1 693	1 801	1 673
Unfilled orders at mills						
Douglas fir	801	791	826	676	710	798
Southern pine	239	273	274	293	217	270
Western pine	439	493	514	454	418	498

	Year					
New orders received by the mills during the quarter	1954	1955				1956
	I	I	II	III	IV	I
Douglas fir	2 387	2 396	2 701	2 126	1 993	2 379
Southern pine	1 952	2 121	2 317	2 283	1 968	2 127
Western pine	2 129	1 891	2 368	2 423	1 933	1 863

Source: Survey of Current Business - U.S. Department of Commerce.

shows that, although the level of stocks at the end of March 1956 was slightly higher than a year earlier, the number of orders both received and unfilled, had not changed perceptibly.

Table 4 shows the development of stocks in relation to production and gross exports or imports in the principal consuming or exporting countries. It is interesting to note that in the main European importing/consuming countries, stocks at 1 January have been rather constantly about one half of the average gross annual imports by these countries in the period 1951-1954, the beginning of 1956 being an exception as a result of stock-accumulation in the previous year. The importance of the stocks in these countries as compared with their domestic production of sawn softwood also emerges from the Table.

As to the principal European exporting countries, stocks at the beginning of each year seem also to have been around one half of the average annual gross exports in 1951-1954, generally representing, however, a somewhat lower share of the total annual trade than in the importing countries. In North America, the relatively low level of stocks as compared with the production finds its explanation in the fact that the bulk of the trade being transacted within the U.S.A., the trade has less difficulties in getting its regular supplies than, for example, in Europe, where a large part of the movement of the trade depends on traditional shipping seasons and the trade therefore has periodically to carry heavier stocks than in North America. On the other hand, the relatively great importance of the stocks in North America as compared with the gross annual exports by that region again confirms the fact that international trade here is more or less of a marginal character and insignificant both with regard to the total production and the total consumption of sawn softwood.

Prices

During the past years the world production of sawn softwood seems to have followed with ready flexibility the changes in demand; supplies have, in general, presented no difficulty to the trade. The main problem of the sawn softwood market, notably in Europe and certain importing regions overseas, has been the rise in the cost of sawnwood. Much has been written about the unfavorable development of sawnwood prices, as compared with its competing materials and about the increased difficulties the wholesale trade has been meeting in trying to obtain from the consumers a price corresponding to the cost of current replacement stocks.

Since 1950, prices of sawn softwood practically everywhere in the world have been marked by a continuous rise, the degree of which has varied between different countries. In certain regions, such as North America, the price of sawn softwood has, during the period 1950–1956, remained markedly stable and does not seem to have risen much faster than the prices of most competing

Table 4. – Stocks of Sawn Softwood

Region		By 1 January				
		1952	1953	1954	1955	1956
		.... *percentage of average, 1951-1954*				
Europe:						
Importing countries[1]	Production	76.1	69.3	74.7	79.2	90.0
	Gross imports	56.4	51.8	55.9	59.3	67.3
Exporting countries[2]	Production	28.0	34.1	28.7	33.1	30.1
	Gross exports	48.2	58.7	49.4	52.3	51.2
North America[3]	Production	16.8	16.7	18.4	16.9	17.1
	Gross exports	146.0	145.4	160.0	146.7	148.7

[1] Belgium-Luxembourg, Denmark, Western Germany, Netherlands, Switzerland and the United Kingdom.
[2] Austria, Norway, Sweden and Yugoslavia.
[3] Canada and the United States.

materials. In other regions, especially in Europe, the development of sawn softwood prices[1] was completely out of line with the general price developments. The rise was particularly significant in countries or regions which depend on international trade for the bulk of

[1] Depending in many instances on high roundwood prices.

their consumption requirements, and consequently the development of the average unit value of world sawnwood exports clearly reflects the rising trend of international prices. Table 5 illustrates the development of the sawn softwood price indexes in a number of countries, compared with the price index of primary commodities (United Nations index). It shows that, while the price of sawn softwood in the U.S.A. has compared rather favorably with the price development of other

Table 5. – Development of Sawn Softwood Price Indexes Compared with that of Primary Commodities

Price index	1950	1951	1952	1953	1954	1955
Sawn softwood (1950 = 100)						
Austria [1]	100	199	243	235	272	328
Sweden [2]	100	155	140	140	147	154
Canada [3]	100	120	126	127	122	128
U.S.A. [4]	100	107	110	102	103	113
Primary commodities (1950 = 100)	100	124	110	103	108	104

[1] Wholesale price for mill run, in Styria.
[2] Average export price for 2½" × 7", u/s redwood, f.o.b.
[3] Wholesale price for Merchantable Spruce 1" × 6/7".
[4] Wholesale price for Douglas Fir No. 1 Common, 2" × 4".

primary commodities, prices of sawn softwood in the principal exporting countries indicate a steadily ascending trend with a growing disproportion between them and the overall price development.

The world prices of primary commodities which in the boom year of 1951 reached record levels have, after the fall in 1952 and 1953, remained by and large unchanged, while the prices of sawn softwood in international trade had, by the end of 1955, either regained or, as in the case of Austria, even exceeded the earlier record levels.

The example of the U.S.A. illustrates very clearly the effect of sufficient domestic supplies which allow timber price developments to adapt themselves to general price trends in the country. In these circumstances, the more or less marginal imports, even if import prices happen to be slightly above the domestic level, do not seriously disturb the domestic price trends. Canada normally disposes of the bulk of its export supplies to the U.S.A. and therefore has more or less to follow the U.S. level of prices in its domestic as well as in its export price quotations. In Europe, where most of the principal importing countries depend on foreign supplies for the bulk of their total requirements, the development of sawnwood prices has largely been influenced by the price determining factors in the exporting countries. It seems that the inflationary trend in most countries of western Europe has been more rampant in the principal sawnwood producing and exporting countries than in those chiefly importing and this has forcibly led to an ever-increasing disproportion between timber prices and the prices of other basic raw materials in the importing countries. Table 6 shows the development of the average unit value index of sawn softwood exports, compared with that of world total exports (United Nations index) as well as the different country unit values of sawn softwood exports.

Table 6. – Development of Average Unit Value of Soft Sawnwood Exports Compared with other Related Unit Values

	1950	1951	1952	1953	1954	1955
Unit value index of world exports of sawn softwood: (1950 = 100)	100.00	148.00	137.00	135.00	130.00	130.00
Unit value index of world exports: (1950 = 100)	100.00	122.00	118.00	113.00	112.00	112.00
Average unit values of world exports of sawn softwood: (U.S. $ per cu.m.)	28.50	42.10	39.50	38.30	37.20	39.01
of which:						
Austria	19.07	30.61	37.25	39.03	33.90	38.46
Finland	26.40	41.00	39.91	40.38	42.08	43.28
Sweden	28.92	44.31	44.15	41.33	42.22	44.18
Canada	30.90	35.70	37.66	35.11	34.36	35.19

Given this development, it is in no way astonishing that the competitive position of sawnwood as a basic raw material, notably in building, has steadily declined in most of the importing countries. Some of these have tried to neutralize this development either by spreading their purchases over an increasing number of exporting countries with sawnwood of different qualities and prices, thus obtaining more favorable averages of imported timber, or by introducing internal price controlling measures. While these efforts have in some instances slowed down the excessive increase of consumer prices of sawn softwood, it has led to disturbances in the trade, particularly with regard to the replacement of stocks. In some of the exporting countries also, the domestic price of sawn softwood has tended to rise faster than that of the principal competing materials, either because the latter were controlled by the authorities — entirely or partially — or because the importance of sawn softwood to certain of these countries' export earnings made it undesirable to check the rise of prices and perhaps encourage domestic demand to the detriment of export trade.

Table 7 illustrates the development of the relationship between sawn softwood prices and those of basic building materials and the general wholesale prices. The figures show that sawn softwood prices have in the principal exporting countries tended to increase more

Table 7. – Price Relationship between Sawn Softwood, Building Material and Wholesale Prices

Country		1950	1951	1952	1953	1954	1955
Austria	1 [a].	100	150	163	162	188	226
	2.	100	149	163	167	185	216
Finland	1.	100	109	117	113	118	130
	2.	100	103	115	112	122	125
Italy	1.	100	140	150	145	144	170
	2.	100	132	164	159	157	184
Netherlands	1 [a].	100	141	122	116	108	107
	2.	100	127	116	119	120	123
Sweden	1.	100	117	98	104	111	113
	2.	100	117	100	107	112	112
United Kingdom	1.	100	135	127	114	113	118
	2.	100	132	130	113	113	118
Canada	1.	100	107	102	99	98	99
	2.	100	107	111	112	112	114
United States	1.	100	98	102	94	95	99
	2.	100	97	103	97	97	107

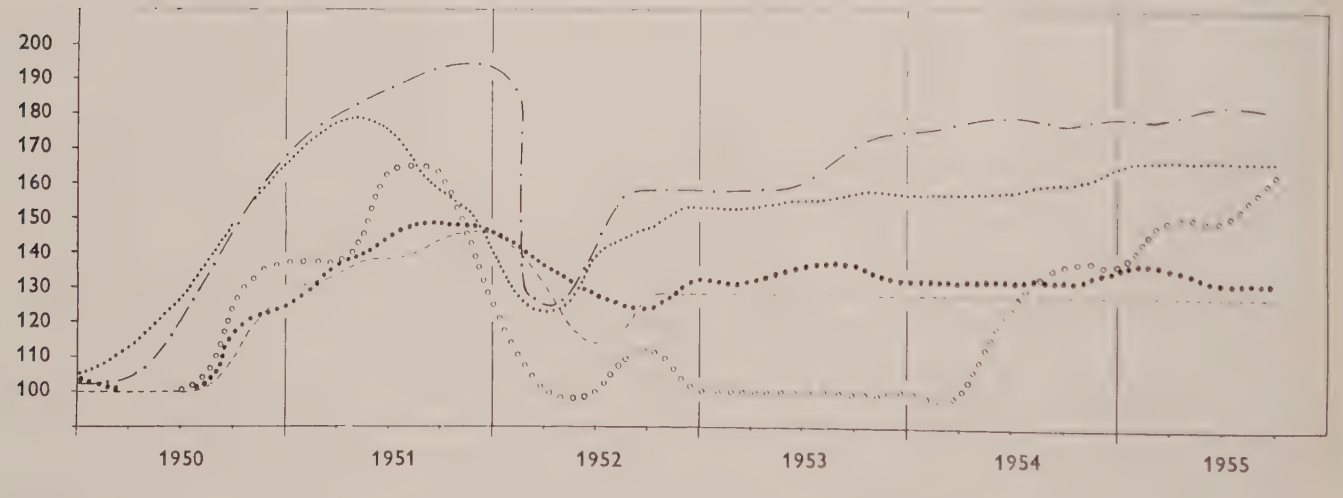
1. Sawn softwood prices in relation to building materials. (Index of building materials = 100)
2. Sawn softwood prices in relation to wholesale prices. (Wholesale prices index = 100).
[a] Bricks only.

steeply, compared with the building materials and general wholesale prices, than in the main importing countries. In the case of North America, the steadiness and even a certain decline of sawnwood prices in relation to other prices is one of the most interesting features of this price comparison, as it demonstrates opposite trends in the two principal sawnwood consuming regions of the world.

The past years have shown constantly rising import prices and simultaneous efforts to keep consumer prices at competitive levels; these developments have been a matter of serious concern to the majority of importing countries which, though struggling with financial difficulties, nevertheless were intent on maintaining supplies to the consumer market at near normal. During these years almost every level of the timber trade has seen the profit margins in importing countries grow narrower or even dwindle, and hopes that the unfavorable effects of the 1951 boom could be wiped out in the course of the following years, have so far proved vain. The developments of sawn softwood prices at different levels of trade in Belgium, as illustrated by the Graph, could also apply to a number of other — notably European — countries. It shows the growing gap between the basic export quotations and the prices obtained on the domestic market.

It is true that the basic quotations (for $2\frac{1}{2}$ inch × 7 inch u/s redwood battens) alone do not give an accurate picture of the development of the average prices paid for imports from the countries referred to, as the latter may change considerably according to the composition, specification and qualities of the wood purchased. With some of the qualities and dimensions becoming increasingly unprofitable, there has been a tendency on the part of the importers to try to obtain more and more of such grades and dimensions as are easiest to sell. This, however, did not always accord with the exporters' wishes, which are dictated by current sawing

Development of Sawn Softwood Prices in Belgium (Index: 1/1/1950=100)



o o o o o o o 1. average Baltic freight rates.

• — • — 2. average f.o.b. prices by Finland and Sweden for Belgium.

..... 3. c.i.f. price of sawn wood from Soviet Union.

••••••••• 4. wholesale price (importers to wholesale merchants).

- - - - - - - - 5. consumer price.

Note. Indications 2 - 5 refer to $2\frac{1}{2}$'' × 7'' u/s redwood battens.

Table 8. – Swedish Comparative Prices of "Fifth-Quality" with Unsorted Soft Sawnwood

Year	Month	Percent
1950	1 January	89.0
	30 June	89.5
	31 December	94.5
1951	30 June	95.0
	31 December	95.0
1952	30 June	84.0
	31 December	90.0
1953	30 June	90.5
	31 December	87.5
1954	30 June	86.0
	31 December	86.0
1955	30 June	86.0
	31 December	83.0
1956	31 May	82.0

practices, the steadily increasing cost of production and by the desire to obtain a reasonably profitable average price for the whole year's production. While the current export quotations thus approach more nearly the actual costs of production at the sawmills, freight fluctuations have become more and more important to the price formation and importers' level. Changes in current freight rates may in fact be decisive as to the possibility of selling the imported goods with a profit or a loss. A feature of the present situation, which may be characterized as a kind of stabilization of prices at a maximum level, is thus that the margin for normal trade speculation has from year to year grown narrower and consequently tends to make the whole structure of trade in sawn softwood much more rigid than before.

Both exporters and importers look for an issue out of the present deadlock, the former by trying to introduce less costly means of production, the latter by looking increasingly around for other sources of supply abroad or by encouraging the national, mostly cheaper, production of sawn softwood.

One of the effects of the past developments on the current prices in international trade has been the growing gap between quotations for higher class sawnwood and prices paid for inferior categories. The changes in the relationship between prices of unsorted sawnwood and those of fifth-quality sawnwood illustrates the gradual decline in the trade value of the latter. Table 8 gives the Swedish price of "fifth-quality" sawnwood as a percentage of that of "unsorted," i. e., superior assortments, over the period 1 January 1950 to the end of May 1956.

A similar development has taken place in the relationship between dimensions currently in good demand and those for which resales at even importers' cost value have in the past years met with difficulty. This process, however, seems to be rather slow as it inevitably tends somewhat to increase the price of more current dimensions as a compensation to the sawmills for the reduced value of less popular specifications.

Conclusion

It is obvious that the present situation on the sawn softwood market in the world, in particular in Europe and those regions which depend greatly on imported supplies, is becoming increasingly acute as far as prices are concerned. Supplies seem to remain quite sufficient and consequently, no appeal can be made to a shortage in sawn softwood, as a justification for any further rise in quotations for this commodity. The factors which determine the current formation of export prices may be said to depend primarily on the general economic developments in the exporting countries; and it may be difficult to change the present course of sawnwood prices unless a general economic stabilization is achieved in those countries whose exports are decisive for the price trend of the whole world market of sawn softwood.

E. K.

The Work of FAO

Mediterranean Forestry Problems

The fifth session of the Joint EFC/NEFC Subcommission[1] on Mediterranean Forestry Problems took place at Nice (France) from 27 to 29 May 1956 and was attended by 35 delegates representing twelve Member Governments. A study tour from Nice to Nîmes following the session enabled the participants to study at first hand some of the governmental undertakings for the development of the southern parts of France.

The Subcommission, for which R. G. Fontaine of FAO acts as secretary, reviewed and endorsed the reports of its working parties on eucalypts and cork-oak, made specific recommendations on the drawing up of ecological maps, and studied and approved for issue a comprehensive report prepared by the Secretariat on the accessory products of the Mediterranean forest.

In pursuance of a recommendation of the expert group on the economic development of Southern Europe of the Economic Commission for Europe (ECE), it was decided to request the Executive Secretary of ECE and the Director-General of FAO to undertake a basic study to deal with the possible contribution from forestry to the economic and social advancement of all the countries bordering the Mediterranean. Following this recommendation the Deputy Director of FAO's Forestry Division, E. Glesinger, and R. G. Fontaine met at Geneva with the Executive Secretary and other staff members of the Economic Commission for Europe, to discuss the bases of such a study and the means to carry it out. It was decided that the scope of the study should be as wide as possible, that the general problem of land use should be thoroughly investigated and that concrete proposals should be made to the governments concerned for a dynamic program of work in the field of forestry.

The meetings of the Mediterranean Subcommission were preceded by the second session of the Working Party on Eucalypts which gave particular attention to the improvement of the planting stock through selection and breeding and to the effects of eucalypt plantations on soil structure. The first experiments carried out seem to indicate that there is no risk of soil deterioration for at least several decades.

Interest in the cultivation of eucalypts is still growing in the Mediterranean basin and techniques are being developed to suit local ecological conditions.

[1] EFC = European Forestry Commission, NEFC = Near East Forestry Commission.

FAO/IUFRO Committee on Bibliography

The Ninth Session of the Joint FAO/IUFRO Committee on Bibliography was held in Oxford on 3-6 July 1956, immediately prior to the Twelfth Congress of the International Union of Forest Research Organizations. The English, French, German and, for the first time Spanish-speaking members of the Committee were present.

The Committee was glad to note that considerable progress had been made in bringing into use the Oxford Decimal System of Classification for forestry literature, prepared on the authority of the committee: 26 countries had been reported as having accepted the system, at differing levels, and five more were considering its adoption. Further progress was anticipated when language editions other than the English were available in print. The German translation was ready, and would be published in early 1957, and the French version would be available some few months later. With the nomination of a Spanish-speaking member to the Commitee, measures were now being taken to commence work on the Spanish translation. A Dutch, a Turkish and an abbreviated form of a Finnish version of the System had been produced, the first two in provisional form pending the Committee's approval of the text.

Some emendations and developments in the English text of the Classification System were submitted for the Committee's approval, and a method of procedure for the submission of further emendations and the publicizing of accepted emendations and developments was discussed and adopted. (Details will be given in a forthcoming issue of *Unasylva*).

Incorporation of the Oxford Decimal System of Classification into the Universal Decimal Classification had, in principle, been settled and there remained only a few details on which agreement still needed to be sought.

Forty-two national and regional centers for forest bibliography were reported to the Committee and the matter of co-operation between these and the three International Documentation Centers of Oxford, Reinbek and Washington was discussed. Recommendations, together with a short note of explanation on the interest of the Joint Committee in bibliographical matters and advice as to how national centers should compile their own national lists, will be circulated in the form of a reprint of an article to appear in a forthcoming issue of *Unasylva*.

A body of basic terms in English for the FAO Multilingual Forest Terminology will be ready toward the end of 1956, and sets of cards are expected to be available to National Committees early in 1957. Thirty-four national or regional Terminology Committees were reported to the Committee, and means of maintaining close contact with these and with any known parallel projects were examined.

Procedure was discussed whereby a revised edition of the FAO *Forestry Abstracts Coverage List* could result in a publication that contained a complete list of all significant periodicals and series of forestry interest published within each country, together with

indications of the coverage, by the respective International Center(s), of the items of literature mentioned. In addition, each title would be accompanied by the reference abbreviation(s) adopted by one or other of the International Centers, and, where relevant, that established by UNESCO in the *World List of Scientific Periodicals*.

At the invitation of the Committee's chairman, Prof. E. Saari of Finland, it was decided to hold a tenth Session in Helsinki, sometime in 1957.

FAO Panel on Forestry Education

In accordance with a request made by the Fourth World Forestry Congress, the Director-General of FAO created a Panel on Forestry Education comprising a selected number of eminent persons from countries in which education in forestry was advanced and characteristic of one or other school of teaching. A first meeting of members of this Panel was held in Oxford on 13 July 1956, for which Professor H. L. Shirley, Dean of the Forestry Faculty at Syracuse University, New York, was designated Chairman. Panel members or their officially nominated alternates from Germany, India, the United Kingdom and the U.S.A. were able to be present and an encouraging number of representatives from many of the leading Forestry Colleges throughout the world also participated in the meeting including Sir Harry Champion who, as Professor of Forestry at Oxford, had been adviser to FAO on forestry education in the early days of the Organization.

The purpose, scope and organization of the Panel were discussed at Oxford, and it was decided that its main attention should be directed to the subject of the university-level training of young men for forest services, industry and research. The Panel will, however, also deal with the educational programs of ranger schools, with types of training programs for forest workers, and with public education about forestry. Special attention will be given to the need for preparing a limited number of men for work in world forestry. The Panel will prepare agenda for discussions on education in forestry for international forestry meetings, and will conduct such special studies on forestry education as FAO or the Panel members may consider necessary.

A number of initial items for which FAO sought guidance from the Panel were tabled, including a revised edition of the FAO *Directory of Forestry Schools*, and the questionnaire on " Forestry Personnel " recently circulated to member countries of FAO with the object of determining the progress made in staffing forestry cadres since 1947, when the first survey was made.

The assistance of the Panel was also sought in determining the minimum requirements, assessed on a national or regional basis, that were necessary for the admission of a Fellow (for example under the FAO Technical Assistance Program) to a school of forestry. Likewise, advice in formulating a recommended minimum program of studies for rangers' schools by regions was sought.

A statement on the new FAO Fellowship Program under the regular program, designed for senior research workers, was tabled for the information of members. This program should give opportunities to universities and institutions to carry out additional high-level research projects of mutual interest to themselves and to FAO.

The chairman outlined the scope of a general comparative study, to be undertaken by the State University College of Forestry at Syracuse University, of types of organization and administration, and of objectives of forestry schools and their relationships to the agencies they serve. In closing the meeting, he expressed his personal conviction that an important and useful task lay ahead of the Panel in fostering international liaison and collaboration among schools of forestry and between those schools and FAO.

Latin-American Forest Research and Training Institute

The appointments have recently been announced of the President and Technical Adviser of the Latin-American Forest Research and Training Institute at Mérida, Venezuela.

The new President is Dr. Antonio J. Uscategui, who up till now has been Dean of the Forestry Engineering faculty at the University of Los Andes. E. J. Schreuder, the new Technical Adviser, received his training in Holland and did graduate work in Germany before going to the East Indies where he worked for 15 years, gaining experience in tropical forest management, the organization of tropical forest industries, including pulp and paper studies, the supervision of planting activities and in logging, extraction and milling operations in hardwoods in the tropical areas of the Far East. In addition, he has now had four years' experience in Central America including general advisory activities and the organization of forest management work in Honduras and participation in educational activities in Turrialba and Puerto Rico.

The immediate job of the Technical Adviser will be one of organization and development. His first tasks, for example, will be to work with the Director in obtaining staff; establishing fiscal and operating procedures; getting the research program underway, under his general supervision, including arrangements for co-operation with the University; and stimulating and obtaining co-operation, including financial support, from other countries of the region which have indicated that they will associate national research stations with the Institute and help support it financially. After the initial organization and arrangements are decided on at Mérida, the Technical Adviser will visit other interested countries of the region and arrange for co-operation and support in exchange of documentation in research and in materials for use on co-operative studies at the new Institute, as, for example, wood specimens, botanical materials, data and information on current research projects, and so on.

Technical Assistance Notes

BRAZIL. *A very young stand of Paraná pine, established from seed in 1951 on* Campo Limpo, *with an average height of 3.60 meters.*

BRAZIL. *A plantation of Paraná pine, seed sown in May 1954, raised in conjunction with the cultivation of maize.*

BRAZIL. Earlier this year the FAO Regional Forestry Officer for Latin America (S. von der Recke) visited the States of Sta. Catarina and Paraná, at the request of the Director of Research of the Brazilian Federal Ministry of Agriculture, to advise on the extent to which the export of Paraná pine lumber should be maintained or decreased.

The Regional Forestry Officer also, on request, visited the State of São Paulo to advise to what extent the State Forest Reserves, hitherto unused, should be opened up to exploitation. The State Governor has now instituted a Forestry Fund from which to finance the reforestation of the State Forest Reserves.

☆

CHILE. *The Yareta at 3,500 to 4,000 meters elevation.*

CHILE. In a report to the Government on the rehabilitation of the arid zone of north Chile through afforestation and reforestation. A. Y. Goor describes the Yareta and pasture belt of the Andes. On the upper slopes of the Andes, at elevations between 3,500 and 5,000 meters, where there is a summer rainfall of 200 to 300 millimeters and where the snow stays on the ground for some time, there is a belt of pasture land covered with a blanket of vegetation, alive or dead, even during the dry season. This area is the grazing ground for herds of llama and alpaca in the north, as well as for goats and sheep further south. It is in this pasture belt that Yareta grows. The Yareta (*Laretia compacta*) is a shrub, the branches of which contain resin and are used as firewood. These shrubs, which at one time must have formed an exotic type of forest, are being cut down at a very rapid rate.

★

PERU. *An FAO officer sends this photograph of a test plantation of Bamboo (Guadua angustifolia) at Tingo Maria. This species is a native of Colombia, Venezuela and Brazil. Many houses in Colombia are built entirely of this timber species.*

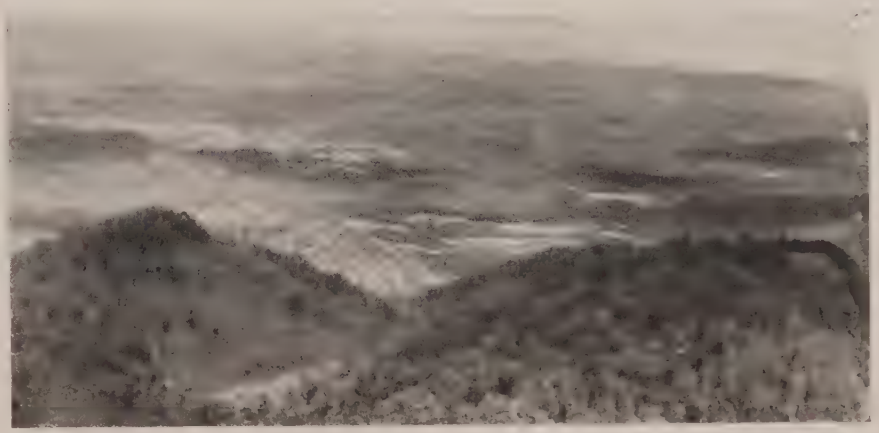
★

ETHIOPIA. *Burnt stumps, dead trunks stretching out their skeleton arms, isolated trees more or less mutilated are all that remain of what was, until recently, the edge of the forest.*

Widespread forests of *Junisperus procera* (locally called "tehd") once covered the highlands in the center of Ethiopia at an altitude of between 2,500 and 3,000 meters. Now only small isolated areas remain, scattered here and there, whose boundaries shrink little by little, nibbled away ceaselessly by clearing for agriculture, fire and grazing. An FAO officer reports that the conservation of wooded areas implies first and foremost the clear demarcation of reserved forest boundaries.

★

HONDURAS. As a major project under the Central American Integration Scheme (an economic collaboration scheme between the countries of the Central American isthmus), concentrated attention is being given in Honduras to pulp and paper development based on raw material from the rather large area of pine forest in the country. One of the principal obstacles to the introduction of rational forest management is the forest fires, and efficient fire protection is a condition for any industrial development based on timber.



HONDURAS. *Character of the Honduras pine forests in the region between Tegucigalpa and Yoro. An aerial view taken during one of the FAO mission's reconnaissance flights.*

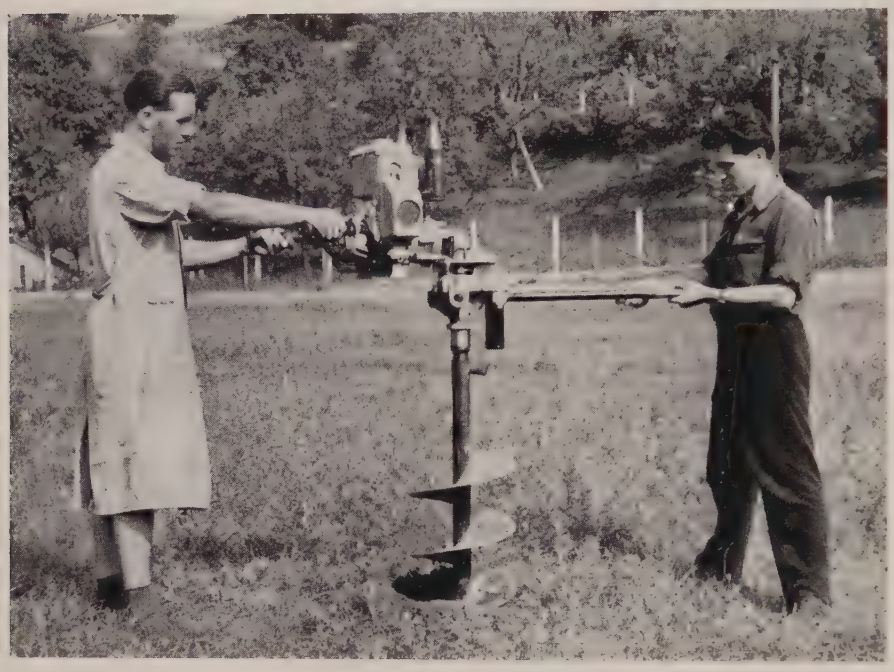
★

JORDAN. Pinus halepensis *forest in Jordan which is being utilized for the grazing of livestock as well as for the production of wood. An FAO forest ecology expert is currently making an ecological survey of such areas to determine their value for forestry and grazing, preparatory to the development of forest management plans.*

HONDURAS. *A pine forest* (Pinus pseudostrobus) *at Santa Cruz, 17 kilometers from Tegucigalpa towards Comayagua. This forest of about 1,000 hectares is an example of what can be achieved in Honduras by proper fire protection. Natural regeneration is satisfactory here.*

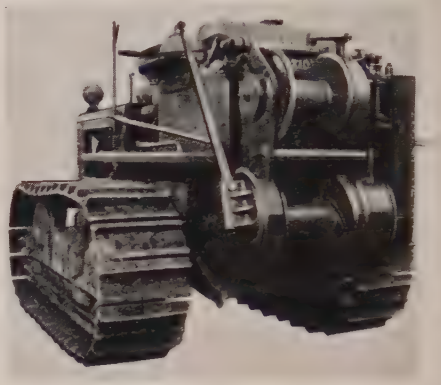
Equipment Section

Interest in the development of forest utilization and woodworking industries is reflected in the continual demand for information on new equipment. The Forestry Division, FAO, collects such information and passes it, on request, to Member Governments: a selection is published here. FAO accepts no responsibility for the claims of manufacturers.



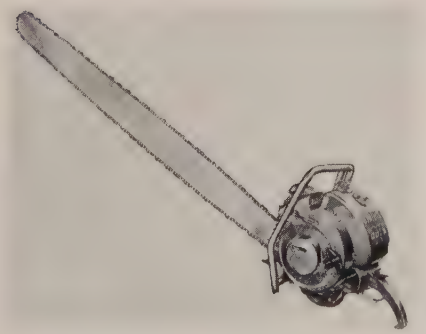
PORTABLE EARTH AUGERS WITH PETROL ENGINE. — Drill can be converted in few minutes to drive several types of tools. Operated by 2 or 4 men, depending on whether tripod is used. Sturdy tripod with built-in rope winch and brake for hoisting auger available in several sizes with different lifting powers and varying strokes. *Specifications:* Augers available in 4 sizes: 4.72, 5.9, 9.84, 13.78 in. (120, 150, 250 and 340 mm.) diameter; standard length of drill 4 ft. 3 in. (1.30 m.). With aid of extension rods, Auger will penetrate to working depth of 82 ft. (25 m.) depending on kind of soil.

Andreas Stihl, Maschinenfabrik, Waiblingen-Neustadt (Württ.), Germany.



AUXILIARY DRUM ATTACHMENT FOR EXTRA HEAVY DUTY WINCH. — Auxiliary drum for International 8 and 9 series crawler tractors permits subsidiary winching operations without uncoupling original load from main winch. Drum has under- and over-winding and provides line pulls at speeds between 188 and 472 ft. (57.3-144 m.) per min. Max.line pull of up to 3,928 lb. (1,780 kg.) at all line speeds.

Drum: T. T. Boughton and Sons Ltd., Amersham Common, England. Winch: International Harvester Company of Great Britain Ltd., Harvester House, 259 City Road, London E.C.1.



ONE MAN CHAIN SAW, MODEL 7-29. — Will bring down trees 10 ft. (3 m.) in diameter. New model 7-29 delivers 7 full hp; weighs only 29 lb. (13 kg.). With all-angle carburetor it cuts in all positions.

Straight blade guide bars available from 18 to 72 in. (46-183 cm.) and Plunge Cut bow guides in 14 in. and 18 in. (36-46 cm.) sizes.

Homelite, Port Chester, New York, U.S.A.

"40" CRAWLER TRACTOR. — *Specifications:* max. belt hp 24.99, drawbar hp 20.14; 4 fwd. speeds: $^{7}/_{8}$, 2 ¼, 3, 5 ¼ mph (1.4, 3.6, 4.8, 8.4 km/h), 1 reverse: 1 $^{3}/_{4}$ mph (2.6 km/h). Engine: 2 vertical cylinders; rated speed 1,850 rpm; turn radius 4-roller: 7 ½ ft. (2.3 m.); 5-roller 8 ft. (2.4 m.). Clearance under chassis: 14 in. (36 cm.). Dimensions: width 67 in. (1.7 m.), length 102 in. (2.6 m.), height to top of grill 50 ¼ in. (1.3 m.) approx; shipping weights: (approx.) 5-roller, 4,560 lb. (2,068 kg.), 4-roller, 4,125 lb. (1,870 kg.). Provision is made for 2 power take-offs, regular (560 rpm) and high speed (1,850 rpm).

Deere and Co., Moline, Illinois, U.S.A.

Silencer Muffler. — For use on McCulloch's saw Models 3-25, 47, 4-30A and 73. Noise level so reduced that normal conversation can be carried on while saw operating. Interior baffle arrangement adds safety feature to muffler, trapping exhaust sparks. Same size as standard muffler, can be fitted on present mounting.

McCulloch Motors Corporation, 6101 W. Century Blvd., Los Angeles 45, California, U.S.A.

Logging Arches. — Designed for logging hardwoods in difficult country. In four sizes for different model tractors with various h.p. ratings, keeping weight of arch matched to tractor pulling machine to avoid unnecessary weight being pulled by tractor.

Isles Forge and Engineering, Grafton Rd., Coff's Harbour, N.S.W., Australia.

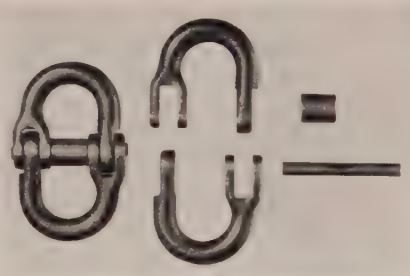
Model J-5 Bombardier All-track Tractor. — Tractor equipped with trailer, winch and equipment for loading and hauling logs. Works over snow, marsh, sand and rough land as well as over solid ground, thick bush and steep slopes.

Specifications: length 9 ft. 4 in. (2.8 m.); width 5 ft. (1.5 m.); weight (without cab) 2,750 lb. (1,247 kg.). Max. speed 25 m.p.h. (40 km.p.h.); cruising speed 18 m.p.h. (29 km.p.h.); ground pressure 1 lb. p.s.i. (0.07 kg. sq. cm.) approx. Turning radius 12 ft. (3.7 m.); track belts 5 ½ in. (14 cm.) endless rubber and rayon; tire 4.50×16 - 6 ply; engine - Chrysler 115 hp; transmission 3 fwd, 1 rev.; differential - controlled type 5.83 to 1; frame construction: monopiece all steel watertight.

Bombardier Snowmobile Ltd., Valcourt, Quebec, Canada.

"Hammerlock" Coupling Link. - New coupling link enables alloy chain users to make up their own sling and special assemblies. Consists of a pair of body halves, a tubular stud and hardened alloy steel pin. Can be assembled in seconds, then securely locked by steel pin which bites into steel stud. No peening or welding required. Link can be disassembled and re-used. For use in joining attachment such as hooks and large links to body chain.

Columbus McKinnon Chain Corporation, Tonawanda, N.Y., U.S.A.

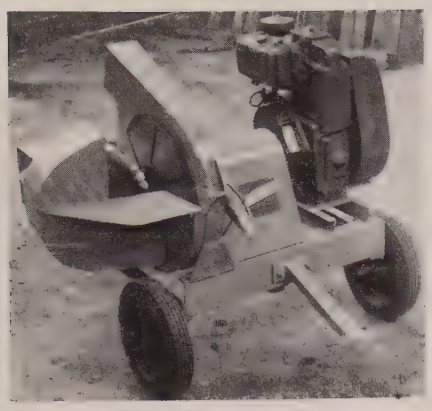


Pull-type Rotary Cutter. — New pull-type model of *Gyramor* 5-ft. (1.5 m.) rotary cutter is heavy-duty brush-cutter, pasture-clipper and stalk-shredder; will fit any tractor having standard drawbar and power take-off.

Cutting height (0-14 in. or 35 cm.) controlled with either remote hydraulic cylinder or manual screw-jack. Single rotor arm with flail-type alloy-steel blade at each end. Three types of blades available – straight, suction and pickup. Shredding attachment can also be installed.

Power transmitted to blades through bevel gears, protected by friction-type slip clutch. Machine-cut alloy-steel gears run in oil in malleable gear-box. Weight: pull-type 1,350 lb. (612 kg.) approx; 3-point pickup models 750 lb. (340 kg.). 15-in. (38 cm.) automobile-type carrier wheels in fwd. position at 80 in. (2 m.) tread, in trailing position at 52-, 57-, 75-, or 80-in. (1.3, 1.4, 1.9, 2 m.) tread.

John Deere, Moline, Illinois, U.S.A.



Disc-type Debarker. — Machine of heavy-duty arc-welded steel designed for rough work in forest. Drive to all-steel feed roller taken through variable speed V-rope drive, and oil-bath reduction gear to safety clutch mounted in center of feed roller. Roller mounted slightly at angle to disc surface, giving end-ways as well as rotary motion to timber. Welded steel covers over all moving parts not in contact with timber. Disc-type barker relieves operator of most of heavy work holding and rotating timber.

Cundeys Ltd., Alfreton, Derbyshire, England.

Electric Dimension Saw, Type ET/E. — For ripping, cross-cutting, mitring, grooving etc.

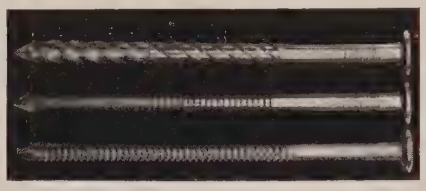
Saw tilts up to 45°; tilting hand-wheel readily accessible from working position. Will carry dado saws or trenching heads.

Riving knife carried from saw frame, and rises, falls and tilts with saw. Top saw guard gives protection with saw set at any angle to table; all adjustments from operator's normal position.

Thomas Robinson and Son. Ltd, Rochdale, England

Hystermonomast. — This fork lift truck always gives operator clear view of fork and load from normal driving position. *Specifications:* Lift height, standard: 10 ft. (3 m.), optional: 8 ft. (2.4 m.); fork length, standard: 36 in. (91 cm.), optional: 30, 42, 48, 54, 60 in. (76, 106, 122, 137, 152 cm.); carriage width: 35 in. (89 cm.); length overall: (less forks) YC-40, 80 ¼ in. (204 cm.), UC-30, 76 ¼ in. (194 cm.); width overall: 38 in. (97 cm.); max. tractive effort: fwd. low, 2,180 lb. at 2.8 m.p.h. (990 kg. at 4.5 km.p.h.), fwd. high, 1,275 lb. at 4.7 m.p.h. (578 kg. at 7.6 km.p.h.), rev. low, 2,290 lb. at 2.6 m.p.h. (1,040 kg. at 4.2 km.p.h.), rev. high, 1,340 lb. at 4.5 m.p.h. (608 kg. at 7.2 km.p.h.). Engine: 4 cylinder, 35 h.p. at governed 2,400 rpm, diesel optional.

Hyster Co., 1,800 North Adams St., Peoria 1, Illinois, U.S.A.

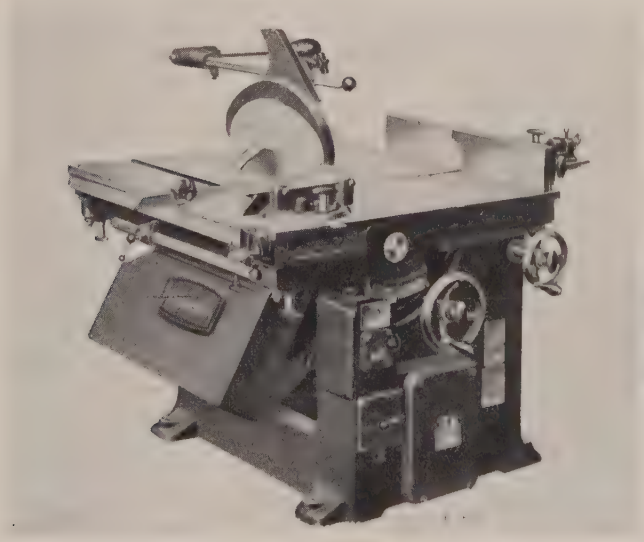


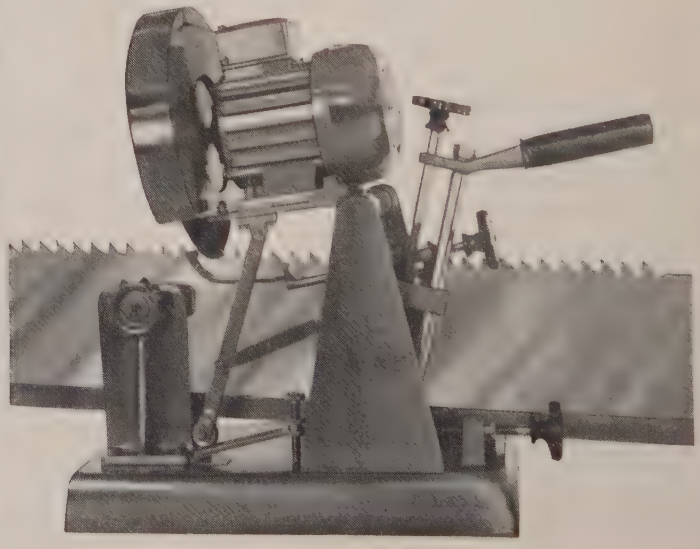
Threaded Nails. — Improved nailing procedures result from introduction and mass production of: 1) helically threaded "Screwtite" nails with medium thread pitch, 2) annularly threaded "Stronghold" nails, and 3) helically threaded "Stronghold Screwnails" with small helix angle for use in wood assembly and building construction. Threaded fasteners manufactured from low-carbon or high-carbon steel and can be driven into hardwoods and concrete. Used in furniture construction, shoemaking and assembly of wooden boats.

Independent Nail and Packing Co., Bridgewater, Mass., U.S.A.

Grinding Machine Type SA-7A/Z. — New patented design for grinding gangsaw blades at smaller sawmills. Grinding operation itself done by hand. Depth and pitch of teeth can be adjusted and shape of each tooth changed by altering jig. Sawblade is put in blade keeper, pushed up against a stop and locked into position. Stop adjusted to inclination of tooth needed so that all sawblades given same form and inclination of teeth.

Söderhamns Verkstäder Ab, Söderhamn, Sweden





News of the World

The items appearing here are condensed from newsworthy material collected by FAO staff or submitted by correspondents. FAO assumes no responsibility for statements and statistics in items accepted in good faith from contributors.

Argentina

• It is reported that, in the province of Entre Ríos, tenders have been invited for tree planting along the main highways which connect the towns of Paraná, Diamante, Victoria and Nogoyá, comprising a total length of 149 kilometers. The plan for the work, and the planting methods and species to be used, were worked out by the Provincial Forest Service. The species are to be mainly eucalypts and pines, with some oak, acacias and poplars.

This system of placing contracts, the forestry enterprise engaging itself to take care of the trees for 18 months, permits the economical carrying out of roadside planting, a great deal of which is urgently required in the province of Entre Ríos. The system might be equally applicable in the rest of the Republic, our correspondent suggests.

Australia

• The Forestry and Timber Bureau, Canberra, has published a Bulletin, Number 33, entitled *General Volume Table for Pinus radiata*. This publication includes a series of tables giving underbark volumes in cubic feet to 4 inches diameter under bark and it is believed will prove most satisfactory in obtaining standing volumes of *Pinus radiata*.

Pinus radiata forms the bulk of the coniferous plantations in Australia, and this species has been grown under a wide variety of climatic conditions and soils. It is not surprising, then, that its form and development should differ from one locality to another. A number of local volume tables have been produced, over the years, but in none of the existing tables is it possible to apply corrections to obtain the volume of a tree which differs in form from the average tree represented in the table.

Belgium

• The Supreme Forestry Council was requested by the Minister of Agriculture to examine the reasons for the harmful effects on fish populations of plantations of conifers along waterways in the Ardennes mountains. The committee set up to conduct an enquiry issued the following findings:

1. The plantations of conifers along the rivers and streams cause fish de-population through destroying the spawning-grounds which is fatal to the natural restocking of the waterways.
2. They result in the disappearance of waterfowl and upset the distribution of the various species.
3. They deprive the Ardennes valleys of their particular character and beauty.

It appears highly desirable that the floors of the valleys, through which the streams and rivers wind, should remain as far as possible open grassland.

From these aspects, there is a problem of national interest which demands urgent legislative action.

The committee proposed:

1. to create an effective protective zone at least 12 meters wide (15 meters if possible) along the watercourses of the Ardennes;
2. to prohibit afforestation or reforestation with coniferous species;
3. to authorize planting and conversion to open stands of deciduous species (mainly poplars) without undergrowth, so as to maintain, as far as possible, a ground cover of grass. Narrow rows of willows, ash and alder would be permitted along the banks of the waterways, since these trees provide shade and coolness in summer, and their tangled root systems afford excellent refuges for fish.

The non-navigable waterways passing through the forests under the control of the forest service are already closed to fishing and are preserved waterways where the fish may breed. Gradual elimination of conifers, it is considered, would greatly improve breeding, and the committee felt that its recommendations should be made applicable to an even wider territory, bounded on the north, possibly, by the Sambre, the Meuse and the Vesdre. However, in view of the objections lodged on behalf of the owners of private properties, the proposals could only be adopted for those areas under public ownership and administered by the forest service.

Burma

• The structural function of wood has been very effectively and imaginatively employed in the construction of the teak domed Assembly Hall of the Engineering College of the University of Rangoon, Burma, described in a report to FAO by the Projects and Planning Officer of the Burma Forest Industries Department. The architects have made it most modern in conception and construction, expressing the impact of modern technology on local conditions and materials, but it is in complete harmony with its background.

During the early investigations into suitable designs, it became evident that only an arched or domed shaped roof could economically be made to cover a rather large area of 10,500 square feet (975 m²) in a single span. The traditional building practice would demand large stanchions and huge girders of steel. The project would be almost impossible with solid timber. But the comparative costs of possible materials, such as steel, concrete, aluminium and timber showed that teak would not only satisfy the aesthetic values of design, but also prove to be much cheaper than most imported materials.

Before construction began, load tests were carried out in England on a 12 feet by 12 feet (3.6 m. by 3.6 m.) section of roof built by the contractors (Taylor Woodrow Construction Ltd.). A special laboratory was used to reproduce the severe climatic conditions of Rangoon, and this test section was subjected to a cycle of rapid drying and wetting 24 hours a day for one month to determine the durability of wood, glue and protective coatings proposed to be used for the project. Normally, the test consisted of two hours' soaking, during which time the temperature dropped to 100° F. (38.5°C) or thereabouts and four hours heating at approximately 190°F. (87.8°C) with a humidity of 90 to 95 percent.

The Assembly Hall, which can accommodate 800 to 1,000 students, is 153 feet (46 m.) long, 93 feet

(26 m.) wide and 38 feet (12 m.) high. It resembles a large turtle shell in shape. The roof or dome is made up of five layers of teak-boards glued and screwed together with layers or laminates at an angle of 45° to each other. The whole roof is, in effect, a huge moulded plywood. The deep overhanging eaves are designed to obviate the necessity of wallings even during the rainy season.

The dome weighs more than 140 tons. It is well supported on two tubular steel portal frames set 111 feet 8 inches apart (33 m.) and eight steel posts on each side of the dome also share the colossal load. Two laminated beams, 12 inches (30 cm.) by 9 inches (22.5 cm.) by 111 feet 8 inches (33 m.) long, are inserted on each side of the dome at 2 feet 3 inches (59 cm.) from the edge to take tension.

The top layer of the roof is to be covered with copper sheets to protect the dome against weathering. Although teak itself is naturally resistant to most enemies of timber, even additional coatings of various proprietory brands of paints and preservatives failed to protect the test sample against the severe test conditions in the special laboratory. The deterioration of the upper surface would seriously affect the stability of the dome and considerably shorten its intended life as the thickness of the roof itself is basically structural.

This remarkable piece of timber engineering with its revolutionary structural principles is a monument to the versalility of wood as well as a tribute to the outstanding qualities of Burma teak. It will also serve as a constant reminder to the future architects and engineers of Burma how the tremendous advances in timber design techniques, promoted by developments in adhesives, timber connectors, calculated dimensions and prefabrication methods, have contributed in overcoming the old limitations of wood and enabling it to compete successfully with steel and concrete in the most exacting engineering requirements.

East Africa

• Tree growth of 35 feet (11 m. 75 cm.) in 23 months was mentioned at the 12th Congress of the International Union of Forest Research Organizations, which is referred to earlier in this issue. The Director of the East African Agriculture and Forestry Research Organization said that a species of eucalyptus, *Eucalyptus saligna*, in East Africa has made this amazing rate of growth, due largely to the fact that the seasons were insufficiently marked to cause any appreciable slowing down. In four years this species produced wood for fuel; in 6 years, poles for native huts; and in 8 to 10 years, timber for permanent houses. The proposed rail link from East African territories to Northern Rhodesia would no doubt help greatly to develop a further market for such timber.

India

• Research work carried out, at the instance of the Ministry of Commerce and Industry, at the Forest Research Institute, Dehra Dun, on the production of high alpha cellulose pulp from *Eucalyptus globulus* has shown that it is possible to use this species for the manufacture of viscose rayon pulp. Blue gum plantations have been raised on the Nilgiri Hills where there are plans to extend the plantations.

The pulp was prepared on a laboratory scale by the prehydrolysis-sulphate process, the yield being about 42 percent, and was tested by a well-known rayon pulp manufacturing firm in Germany, whose report was positive.

This is the first time that viscose rayon pulp has been prepared in India, even on the laboratory scale, from wood grown in the country. Other species are being tested.

Iran

• The nomination of General Akhavi as Director-General of the Forest Administration, and a decision to entrust the army with the protection of the forests in zones where the forest service has not yet been built up (for instance in the south and west of Iran), shows that the authorities are fully aware of the importance of the country's forest resources and have decided to assure their rigid protection, even if this involves some friction

The new organization of the northern forests comprises 12 conservancies, under the control of four Inspectors-general. In each conservancy a system is being introduced gradually whereby every forest guard would control 2,500 hectares; four guards would be grouped under one brigadier (10,000 ha.); three brigades would constitute a sub-inspectorate (30,000 ha.), three sub-inspectorates would make an inspectorate (90,000 ha.), and three inspectorates one conservancy (270,000 ha.). The rest of the country will also come under the general protection of the army, especially in regard to fire-protection and control of cutting. A regular forest service will be progressively extended and established over the coming years.

An FAO Forestry Mission has been serving in Iran for some years.

Ireland

• Agriculture is of primary importance to Irish economy and national policy is directed towards the expansion of agricultural productivity to the greatest possible extent. The national forest policy must of necessity be ancillary to, and not in conflict with, the drive for the development of agricultural resources. This factor has a most important effect on the acquisition of land for forestry. Agricultural land of high quality is not acquired for forestry purposes except in the case of land required for nursery purposes. Of course, small enclaves of agricultural land may sometimes be acquired with large surrounding areas of land primarily suitable for forestry purposes, but this is unavoidable. It may be stated generally, therefore, that it is forest policy to afforest only such land as is inferior or substandard from an agricultural point of view.

An important feature of forestry activities in recent years has been the planting with mechanical assistance of extensive peat areas which would have been incapable of economic development by traditional manual methods. There are very large tracts of such land available in the country and if, as is hoped, recent experimentation establishes definitely that the planting of such land is an economic proposition, there will be room for much greater expansion of forestry operations on peat soil-types, particularly in the underdeveloped areas along the western sea-board where additional sources of productivity and of steady employment are badly needed.

Labor requirements for forestry do not conflict to any appreciable extent with the needs of agriculture. In fact, a large part of the forestry labor force is drawn from the ranks of small farmers with uneconomic holdings or the sons of farmers whose holdings are incapable of providing a livelihood for them. When it is borne in mind that the average size of the Irish farmer's holding is small (the total arable land is divided into 379,637 holdings), it will be realized that forestry provides a valuable additional source of employment for the surplus labor available in rural districts and assists in stemming the flow of migration to urban areas and of emigration to other countries.

Switzerland

• In order to ensure desirable co-operation between all departments and private individuals interested in the raising and utilization of poplar, a Swiss Poplar Working Party has been formed, with the aim of facilitating and improving poplar production through propagation of high quality planting material, and properly organizing its distribution. Membership is open to anyone interested in poplar cultivation and prepared to co-operate.

At a first meeting, the working party discussed problems of controlling the growth of various poplar varieties bred at the central nursery in Zurich, and the establishment of a public information service. In order to determine the localities suitable for poplar plantations, it was proposed that a poplar register be established in co-operation with the federal and cantonal departments dealing with agriculture, country planning, and protection of nature.

United Kingdom

• An Institute of Wood Science came into existence in December 1955, when it was incorporated under the Companies Act. The need for such an institution had been felt for a considerable time and has become more urgent since nation-wide courses on timber technology were organized in 1945. Many past students of these courses have maintained or increased their interest in wood science, and it was with the feeling that some national body should be formed, that a number of those interested in the project met; from their many discussions the new Institute was born.

This original committee was representative of all branches of wood science and among its members were wood technologists, botanists, chemists, consultants, representatives of the timber trade, technical colleges, and technical associations. The name "wood science" was chosen because it includes all aspects of the scientific study of wood from anatomy to the chemistry of wood adhesives, and from kilning to the design of wooden structural units.

As stated in the Articles of Association, the purpose of the Institute is "to advance the scientific, technical, practical and general knowledge, of persons interested in the study of wood and allied subjects." It will be seen therefore, that the Institute will cater for the broadest possible interests of those concerned with the technical aspects of wood and its utilization.

It is intended to publish a *Journal of Wood Science* which will contain original articles dealing with all aspects of wood science, and in which there will be considerable space devoted to reviews and summaries of current research, and a news bulletin, containing summaries of talks, book reviews, announcements of meetings, and other relevant matter, which should be of interest to the members, and which will keep them informed of the nation-wide activities of the Institute.

United States of America

• Press reports have spoken of industry plans to construct a completely integrated forest products manufacturing plant, at a cost estimated at about $15 million, which will be the first such development in the State of California. The plant is scheduled to be completed in 1957.

In addition to facilities for processing lumber, including a sawmill, drying kilns, and a planing mill, the new installation will be designed to include a molded pulp plant which will convert lumber and wood residues into fibre products.

The plant is designed with an initial capacity to process some 85 million board feet of lumber annually, and the molded pulp plant, which will manufacture products from mechanically-produced groundwood, will have an initial rated capacity of 30,000 tons a year.

Development is said to have hinged upon the elimination of any possible effluent disposal problem.

"The methods developed by scientists and engineers to achieve full-log utilization, includes the use of an effluent treatment plant which encompasses the very latest in design and engineering principles of water purification systems. This controlled treatment plant, plus the use of secondary settling basins which will be completely separated from the river, will insure the return of water to the Sacramento river as clear and pure as that obtained by any municipality on the river."

Products to be produced will include egg cartons; disposable plates for home, industrial and institutional use; pie and cake plates for bakeries, and molded pulp containers used for pre-packaging meats and other food sold in self-service markets.

• A committee of the Society of American Foresters on the history of forestry in the U.S.A. has studied the need for and feasibility of preparing a series of histories covering comprehensively the many aspects and institutions in the entire diversified field. Various histories covering one phase or another have appeared in the past, such as Gifford Pinchot's personal memoirs, the histories of several of the older forest schools and the like, but the committee concluded that coverage to date and in prospect is piecemeal and incomplete, and thus proposed an aggressive program, sponsored and financially supported by the Society, to speed up the work.

One cause for urgency is that so many of the senior foresters who were active and leading participants in the history have vanished, and mortality rate among survivors is high. Much of the historical record is in the form of closed institutional files containing correspondence and manuscript reports, and such material tends to vanish since few institutions are zealous in preserving it.

A few pieces of work are under way on an individual basis, including a history of the origins and development of the State Division of Forestry in California under preparation by C. R. Clar, a member of the Division, and a history of the development of forest fire control on the National Forests in California by S. B. Show, long a member of the U.S. Forest Service and afterwards serving with FAO. The committee recognized that pioneering in these fields was of particular significance and interest, but there were other areas such as range management and the development of organization, personnel and administration which were of live interest as well.

In addition to histories in the functional fields, the committee seeks for histories of the main institutions, such as the American Forestry Association and the Western Forestry and Conservation Association which did notable work in the western U.S.A. A history of the first 25 years of the Forest Service was under preparation by W. B. Greeley, a former Chief of the Service, at the time of his death, and there is no readily available person to carry on and complete this work.

Though there are formidable difficulties in financing the costs of preparation and publication of such a series, the outlook is at least hopeful for the Society's project.

Correction

In *Unasylva* Vol. 10, No. 3, News of the World, page 144, the heading "Germany (Federal Republic)" should read "Austria".

Book Notices

Wood Handbook, Forest Products Laboratory, Forest Service, U. S. D. A., Handbook No. 72, pp. 528, U.S. Government Printing Office, Washington D.C., 1955, $2,00.

In 1910, when the Forest Products Laboratory of the U.S. Forest Service was established at Madison, Wisconsin, it became the first institution in the world devoted entirely to general research on wood and its utilization. In the ensuing years, a continuing and expanding program permitted the accumulation of a monumental amount of information which is here incorporated in a handbook designed as an aid to better and more efficient use of wood as a material of construction.

The mere listing of the chapters is indicative of the comprehensive coverage: structure of wood; characteristics of some important commercial woods grown in the U.S.; physical properties of wood; strength values of clear wood and related factors; grades and sizes of lumber; stress grades and working stresses; timber fastenings; solid and built-up structural members; gluing of wood; glued structural members; plywood and other crossbanded products; structural sandwich construction; bent wood members; control of moisture content and shrinkage of wood; fire resistance of wood construction; painting and finishing wood; protection from wood-destroying organisms; wood preservation; poles, piling and ties; thermal insulation; building fibreboards; and modified woods and paper-base laminates.

After each chapter the significant literature is given. The carefully prepared index and a glossary of terms complete this invaluable handbook.

Tecnologia del Legno (Wood Technology) - G. Giordano, Volume II. Il legno dalla foresta ai vari impieghi (Wood extraction and utilization) pp. 950, ill. 871. Ed. Hoepli, Milan. 1956. L. It. 8,500.

This book, by Professor Giordano of the University of Florence, follows a first volume devoted to wood properties. Expressing the author's very extensive experience, it covers all logging and extraction operations in the forest and primary conversion, wood-working machinery, and the operation of sawmills.

The first part dealing with forest exploitation, includes chapters on the selection and marking of trees, felling, conversion and preparation of roundwood products and the work and labor involved, maintenance of tools, extraction and transportation (comparing trends in the U.S.A., the U.S.S.R. and Europe), and estimates of costs for all the various operations and phases examined.

The second part concerns the layout and operation of sawmills and woodworking machinery, while in an appendix the author expounds his ideas on methods of improving productivity both in the forest and in woodworking industries.

This volume is not only a students' textbook. With its 950 pages, it constitutes a kind of compendium for technicians and foresters. It gives practical advice on how to obtain the best results with a minimum of expense, always against a background of good silviculture and sound forest management.

Maderas y bosques argentinos. (Timbers and Forests in the Argentine). Lucas A. Tortorelli. pp. 910. illus. Editorial Acmé S.A.C.I., Buenos Aires, 1956.

The flora of South America includes a vast number of tree species, the majority of them being known only to the botanists. In fact, the silvics and dendrology of South America are today one of the main unknowns of forestry. Within most countries, scarcely 10 percent of the known species are utilized in one way or another although they include timbers of very varied qualities which could certainly add a great many commercial species to industry.

This work of Professor Tortorelli must be considered against this background, and it represents a valuable contribution toward a better knowledge of South American timbers and forests. It completes the author's 1940 publication on Argentine timbers.

The main part of the book which carries a preface by Professor Ph. Guinier, is concerned with the structure and properties of 111 species of Argentina, and contains a key to the identification of the woods described in the text which is, we believe, the widest in scope yet published originally in Spanish. In addition, there is a good collection of microphotographs, and an extensive bibliography listing some 400 references.

Professor Tortorelli's work is the fruit of a great effort to overcome the confusion reigning over the identification of many species and to encourage the opening of new markets for them. It is to be complemented by a more detailed descriptive study of the forest types in Argentina.

Handbook for Teaching of Conservation and Resource-use. Richard L. Weaver, The National Association of Biology Teachers in conjunction with The American Nature Association, pp. 499, The Interstate Printers and Publishers, Inc., Danville, Illinois. 1955.

In 1952, the National Association of Biology Teachers in the U.S.A. organized a conservation project designed " to develop and promote the acceptance of a set of criteria of objectives which can be documented by actual illustrations of good teaching techniques, particularly by biology teachers, and which can be used to stimulate many more teachers to increase the emphasis on conservation ". The project was organized with state committees, executive and advisory committees, and regional committees and, after three years' intensive work, has reported.

The report is in the form of a handbook or casebook primarily reporting in the teachers' own words projects in the broad field of conservation which they individually worked out and applied to meet the particular needs and opportunities of their own classes. Teachers everywhere, and particularly biology teachers, were offered opportunity to contribute, and many did so.

A wide variety of projects was reported, using all sorts of techniques for teaching and involving both classroom and field work. Perhaps the central theme is that a successful project in the individual school needs to be closely connected with the particular environment of the school and of the pupils.

Most of the projects reported dealt with conservation not as a thing apart but as an integral part of biology. That this approach was effective is evident from the accounts of individual projects.

The following is a list of the aids available to teachers in preparing their projects: bibliography of free and inexpensive material for conservation and resource-use education; a conservation bibliography; conservation in high-school biology texts; conservation films and filmstrips. The handbook gives abundant evidence of what can be accomplished in this generally neglected field given enthusiasm, imagination and will, and although it is specific to one country, it may well contain useful suggestions for those in other countries who are concerned with developing the teaching of conservation to young people.

THE LAW OF FORESTRY. W. A. Gordon. pp. 574. Her Majesty's Stationery Office, York House, Kingsway, London, W. C. 2. £ 3.10s.

Primarily a basic reference work for British foresters, administrators and civil servants, this book is in addition something more and is recommended for reading to all those concerned with the difficult matter of framing legislation appropriate to official forest policy on the one hand and, on the other, adapted to local circumstances and environments.

The various laws relating to the United Kingdom and overseas territories are described here with appropriate commentaries and are set against their historical backgrounds. The author offers not only a critical analysis but an account of the discussions that led to a law's framing and the reasons for which it was shaped into its final form. Forest laws, and particularly the regulations implementing them, may often require to be adapted to changing circumstances; the United Kingdom has had four basic Forestry Acts between 1919 and 1951. The problems requiring solution vary with time. It is, therefore, all the more necessary to seek the fundamental guide line on which sound forest laws can be based, and this is just exactly what Mr. Gordon's method of presentation makes possible. The book provides ample material for reflection.

The author has perhaps the unique distinction of holding at once a Masters degree in Forestry from Oxford University and a Diploma in Anthropology: he is a barrister-at-law, and he has had wide experience in many territories. He has had the collaboration of many well-known authorities in compiling his treatise.

The book is divided into two main divisions of almost equal length. The first, concerning the law of forestry in Great Britain, is further subdivided into two parts, the first giving a succinct account of British law in general, particularly that referring to landed property, while the second deals specifically with the law of forestry in Britain.

A background of general principles is essential to the understanding of any forest laws, but particularly so in the case of Britain, which did not have any forest law proper before the end of the first world war. The author in fact considers that the only law that really expounds a forest policy is the Forestry Act of 1951. This is perhaps an extreme view because forest policy is often implicit in a forest law rather than specifically spelled out, especially when most of a country's woodlands are privately-owned. However, except for the old royal forests, to which a special section of the book is devoted (and in which very interesting details on the management of the New Forest and the Forest of Dean are given), the other woodlands of Great Britain were never governed by special landed property laws prior to 1951.

Since forests are a particular kind of property, and jurisprudence, i.e., the interpretation of the law by the courts, necessarily leads to the laying down of special rulings in regard to timber and forests, the description of these rulings which are particularly complex in Britain, takes over 100 pages. And since, except in case of overthrow by revolution, laws are the product of a continuous evolution deeply rooted in the past, the doctrine thus gradually evolved could not fail to have a very strong impact on the Forestry Acts promulgated by Parliament in the past 35 years.

The second half of the book is concerned with forest law in the overseas territories of the United Kingdom. Part IV gives remarkably fully documented studies on Kenya, Tanganyika, Cyprus, Nigeria, the Gold Coast, British Guiana, the Fiji Isles and Northern Rhodesia (the latter four countries being dealt with by H. A. Douglas, R. R. Taylor, G.W.G. Cattle and A.P.H. Hamilton respectively). Part III contains a general description of the conditions under which forest laws were framed for the colonial territories that have been, or are still being, governed by Britain. The author stresses the main land abuses prevalent in the past and still obtaining, leading to forest degradation or destruction, and describes methods of protecting forests against such abuses particularly, of course, by reservation and circumscribing, regulating or eliminating rights of user burdening them. At the end of this section (Chapter 44), there is a model text of an Ordinance, obviously conceived of merely as an ideal law but which, with the commentary on it, is very useful. Mr. Gordon's general remarks on forest law could be read and digested with profit by foresters of many countries where similar problems still exist and who seek to formulate legislation that will enable them to solve such problems, while at the same time implementing sound forest policies.

The author is rightfully surprised that foresters in countries where there was as yet no declared forest policy or previous forest law, were able not only to frame but also to have accepted, sometimes very successfully, uniform policies and laws suited to the needs of each territory. He attributes this success in general to the fact that, in most of the countries concerned, land law was not highly evolved, and the ownership of most of the forests was either undetermined or considered as vested in the State. This is perhaps a weak point, because it is not clear that land law (naturally in the broad sense and most frequently in the form of tradition transmitted orally rather than by custom) did not actually exist in these countries. For instance, the very complex principles generally recognized by all Moslem countries and which constitute law, apply not only to privately-owned land but also to land without any specific ownership (vacant land). European-style laws have been superimposed on such local law in some countries; one cannot even say categorically that they are Anglo-Saxon laws because the foresters who proposed them had been partly trained in the forestry schools of Continental Europe and some features, such as the right of transaction or dealings in forested land, afford particularly striking evidence of this influence.

While the superimposed laws have become part of the law of the land wherever the old land law had some affinity with them, the failure in application of certain provisions may perhaps also be explained from this starting point.

Errors of detail can be gradually corrected, and it can be said that if there is the manpower to enforce it, a poor law may be sometimes better than no law at all. These considerations should however inspire caution and thorough study whenever an attempt is to be made to codify into a complete body of forest law, individual laws or even mere customs relating to land ownership or usufruct. It is not surprising that, in many countries, there are at least two land laws governing vacant land to which no private person holds title, and particularly forests — the official law of the land on the one hand, and on the other the law recognized by the tribes, communities, families and individuals, which is the only law actually holding good.

The goal of foresters is not only to bring these two laws into line with one another, but to harmonize them in such a manner that they may become the instrument of sound forest policies.

This is only one of the thoughts that comes to mind from the reading of Mr. Gordon's book. Each page suggests many others, and that is why the reading of this book is heartily recommended, despite perhaps the dryness of the subject-matter, which is delightfully relieved by the author's clear and sometimes lightly mischievous manner of presentation.

CLASSIFIED INDEX - Volume 10 - 1956

NOTE: *Throughout this index the first number in each group of two numbers refers to the issue, the second to the page.*

Index of Titles

Articles

BAMBOO CULTURE IN THE SOUTH PACIFIC, F. A. McClure, **3**, 115
CONTROL OF BRUSH AND UNDESIRABLE TREES, A. W. Sampson and A. M. Schultz, **1**, 19; **3**, 117; **4**, 166
EUCALYPT WOODLAND IN AUSTRALIA, M. R. Jacobs, **3**, 111
FORESTRY ASSOCIATIONS, T. François, **2**, 59
FORESTRY EXTENSION SERVICES IN THE FEDERAL REPUBLIC OF GERMANY, U. Hahn, **1**, 17
FOREST PROTECTION IN THE U.S.S.R., **3**, 130
HOUSING DEVELOPMENT IN INDONESIA, Inter-Secretariat Working Party, **1**, 3
NATURAL FORESTS OF CHILE, A. Hyndman Stein, **4**, 155
SCIENTIFIC NOMENCLATURE OF FOREST TREES, L. Little, Jr., **4**, 183
STUDY OF TROPICAL VEGETATION, P. Richards, **4**, 161
WOOD SACCHARIFICATION, J. A. Hall, J. F. Saeman and J. F. Harris, **1**, 7

Commodity Reports

Forestry and Forest Industries in Russia's Sixth Five Year Plan, **1**, 3
Plywood, **3**, 133
Sawn Softwood, **4**, 186

Equipment Section

1, 37; **3**, 138; **4**, 196

News of the World

AFGHANISTAN **1**, 45
ARGENTINA: **4**, 199
AUSTRALIA: **1**, 45; **3**, 141; **4**, 199
AUSTRIA: **3**, 141, 144
BELGIUM: **4**, 199
BULGARIA: **1**, 45
BURMA: **4**, 199
CANADA **1**, 46; **3**, 141
CEYLON **1**, 46; **3**, 142
CHILE: **3**, 143
COSTA RICA: **1**, 46
COLOMBIA: **3**, 143
CUBA: **3**, 144
EAST AFRICA: **4**, 200
ECUADOR **1**, 46; **3**, 144
EGYPT: **1**, 46; **3**, 144
FRANCE: **1**, 47
FRENCH GUIANA: **1**, 47
GERMANY (FEDERAL REPUBLIC): **1**, 48
GERMANY, EASTERN: **3**, 145
GUATEMALA: **3**, 145
HUNGARY: **3**, 145
INDIA: **1**, 48; **3**, 145; **4**, 200
IRAQ: **3**, 146
IRAN: 4, 200
IRELAND: 4, 200
KENYA: **3**, 146
MEXICO: 1, 48
NEW GUINEA: **1**, 48
NEW ZEALAND **1**, 49
NIGERIA: **1**, 49
NORWAY: **1**, 49
PAKISTAN: **1**, 50
PERU: **1**, 50
PHILIPPINES: **1**, 50; **3**, 146
POLAND: **1**, 51;
ROMANIA: **1**, 51
SWEDEN: **3**, 147
SWITZERLAND: **4**, 201
THAILAND: **3**, 146
TRINIDAD: **1**, 51
TUNISIA: **1**, 52
TURKEY: **3**, 147
UNITED KINGDOM: **1**, 51; **3**, 148; **4**, 201
UNITED STATES OF AMERICA: **1**, 51; **3**, 149, **4**, 201
UNION OF SOVIET SOCIALIST REPUBLICS: **1**, 53
YEMEN: **3**, 150
YUGOSLAVIA: **1**, 54

Book Notices

BIBLIOGRAPHY OF PLANT PROTECTION: J. Bärner, **3**, 151
CONTRIBUTIONS TO PLANT ANATOMY: I. W. Bailey: **1**, 55
DAS HOLZ ALS ROHSTOFF: R. Trendelenburg and H. Mayer-Wegelin, **1**, 56
EL EUCALIPTO: J. P. Vidal, **3**, 151
FLORE DES VÉGÉTAUX LIGNEUX DE LA MARMORA: A. Métro and Ch. Sauvage, **3**, 152
FOREST TREES OF SARAWAK AND BRUNEI: F. G. Browne, **3**, 151
FORESTER'S COMPANION: N.D.G. James, **1**, 55
FORESTRY HANDBOOK: R.D. Forbes, **1**, 55
GROWTH HABITS OF THE EUCALYPTS: M.R. Jacobs, **3**, 155
HANDBOOK FOR TEACHING OF CONSERVATION AND RESOURCE-USE: R. L. Weaver, **4**, 202
LAW OF FORESTRY: W.A. Gordon, **4**, 203
MADERAS Y BOSQUES ARGENTINOS: L.A. Tortorelli, **4**, 202
TECNOLOGIA DEL LEGNO: G. Giordano, **4**, 202
TECHNOLOGIE DES HOLZES UND DER HOLZWERKSTOFFE: F. Kollmann, **1**, 55
WALDBAU, ANSPRACHE UND PFLEGE VON DICKUNGEN, WALDPFLEGE: J. N. Köstler, **3**, 152
WATER: Ed. Alfred Stefferud, **1**, 55
WOOD HANDBOOK: U.S. Forest Service, **4**, 202

The Work of FAO

FAO PANEL ON FORESTRY EDUCATION: **4**, 193
JOINT COMMITTEE ON FOREST WORKING TECHNIQUES: **1**, 34
FAO/ECE JOINT WORKING PARTY ON FORESTRY AND FOREST PRODUCTS STATISTICS: **1**, 36
FAO/IUFRO COMMITTEE ON BIBLIOGRAPHY: **4**, 192
LATIN-AMERICAN FORESTRY COMMISSION: **1**, 33
LATIN-AMERICAN FOREST RESEARCH AND TRAINING INSTITUTE: 4, 193
MEDITERRANEAN FORESTRY PROBLEMS: **4**, 192
STATISTICAL SEMINAR - DEHRA DUN: **1**, 34
TEAK SUBCOMMISSION: **3**, 137
TECHNICAL ASSISTANCE NOTES: **4**, 194
TECHNICAL PANEL ON WOOD CHEMISTRY: **3**, 137

Index of Authors

FRANÇOIS, T.
Forestry Associations, **2**, 59

HAHN, U.
Forestry Extension Services in the Federal Republic of Germany, **1**, 17

HALL, J.A., SAEMAN, J.F. and HARRIS, J.F.
Wood Saccharification, **1**, 7

INTER-SECRETARIAT WORKING PARTY
Housing Development in Indonesia, **1**, 3

JACOBS, M.R.
Eucalyptus Woodland in Australia, **3**, 111

LITTLE, E.L.
Scientific Nomenclature of Forest Trees, **4**, 183

MCCLURE, F.A.
Bamboo Culture in the South Pacific, **3**, 115

RICHARDS, P.
Study of Tropical Vegetation, **4**, 161

SAMPSON, A.W. and SCHULTZ, A.M.
Control of Brush and Undesirable Trees, **1**, 12; **3**, 117; **4**, 166

STEIN, A.H.
Natural Forests of Chile, **4**, 155

TIPOGRAFICA CASTALDI - ROMA - 1956

FORESTRY AND FOREST PRODUCTS STUDIES

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